UNITED NATIONS

Framework Convention on Climate Change

Distr.
GENERAL

FCCC/SBSTA/2000/3

11 May 2000
ENGLISH ONLY

SUBSIDIARY BODY FOR SCIENTIFIC AND TECHNOLOGICAL ADVICE
Twelfth session
Bonn, 12-16 June 2000
Item 8 (a) of the provisional agenda

# METHODOLOGICAL ISSUES

# LAND-USE, LAND-USE CHANGE AND FORESTRY

## Synthesis report on national greenhouse gas information reported by Annex I Parties for the land-use change and forestry sector and agricultural soils category

## Note by the secretariat

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# I. INTRODUCTION

## A. Mandate

1. The Subsidiary Body for Scientific and Technological Advice (SBSTA), at its eleventh session, requested the secretariat to compile and synthesize information on the completeness and comprehensiveness of Annex I Party national greenhouse gas inventories for the agricultural soils and land-use change and forestry (LUCF) categories (FCCC/SBSTA/1999/14, para. 46 (l)).

## B. Scope of the note

2. This note responds to the above mandate by synthesizing the information most recently submitted by Annex I Parties for the agricultural soils category and land-use change and forestry sector. In general, such submissions follow the structure of the 1996 Revised Guidelines for National Greenhouse Gas Inventories of the Intergovernmental Panel on Climate Change (IPCC), (referred to here as the IPCC Guidelines), as the SBSTA decided, at its fourth session, that the IPCC Guidelines should be applied by Annex I Parties on a mandatory basis for inventories due in 1998 and beyond (FCCC/SBSTA/1996/20, para. 30). Decision 2/CP.3 (FCCC/CP/1999/7/Add.1) reaffirms that Parties should use these guidelines to estimate and report anthropogenic emissions by sources and removals by sinks under the Kyoto Protocol.

3. The IPCC Guidelines were developed to facilitate the reporting of greenhouse gas (GHG) emissions from sources and removals by sinks under the Convention. The Guidelines do not address the special reporting needs of some aspects of the Kyoto Protocol, such as Article 3.3 and 3.4. However, this note follows the structure of the IPCC Guidelines by synthesizing information on emissions and removals of all GHGs in the LUCF sector and the agricultural soils category. The note also analyses the initial and most recent base year data for these categories. In addition, it synthesizes information on methods and sources of data used by Annex I Parties.

## C. Approach

4. The information sources used by the secretariat are summarized in table 1. The secretariat generally relied on data provided by Annex I Parties in their most recent annual GHG inventories.[1] If an annual inventory was not available for a particular Party, the most recent national communication (NC) was used.

5. GHG inventories were used for 31 Parties and NCs for five.[2] Of the 31 inventories, 25 were submitted in 1999. In 22 of these cases, the last year for which data were reported was 1997. Two inventories included data for 1998, and one Party reported data for 1996. Six Parties submitted their most recent inventories in 1998: the last year for which data was reported was 1996 in five instances, and 1995 for one Party.

6. NCs were the source of data from five Parties. The latest reported data for Iceland and Italy were for 1995, and for Portugal and Romania 1994. Slovenia's first NC and Liechtenstein's report both reported data for 1990 only.

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[1] Annual inventories submitted in year 2000 were not considered.

[2] Liechtenstein did not submit any inventories or NCs. Instead a report submitted in 1995 was used for the purpose of this synthesis. Although Luxembourg has not submitted a second NC, it provided an inventory in 1998 (which was used in this document) for consideration in the second compilation and synthesis of second NCs.

7. The annual GHG inventories and the NCs contain data for various years. However, for the period 1990 to 1997 there is not one single year for which all Parties have submitted data on LUCF and agricultural soils. Consequently, it was decided to use the following years for this synthesis[3] (see also table 1):

| | |
|---|---|
| 1997: | 24 Parties (65 per cent of all Annex I Parties) |
| 1996: | Hungary, Ireland, Luxembourg, the Netherlands, the Russian Federation and Slovakia |
| 1995: | Iceland, Italy and Spain |
| 1994: | Portugal and Romania |
| 1990: | Liechtenstein and Slovenia. |

8. Parties may wish to carefully review the data presented in this note, because in some instances, the data presented in national communications differed from data provided in national inventories, requiring the secretariat to make assumptions about which data were appropriate. The most efficient way for Parties to clarify or correct data is in their annual GHG inventory submissions.

## D. Possible action by the SBSTA

9. The SBSTA may wish to take note of the information in this document, particularly when considering Article 3.3 and 3.4 of the Kyoto Protocol and any future guidance to the IPCC.

[3] The data for 1998 submitted by Germany and Ukraine were not used in this synthesis.

**Table 1: Sources and reporting of information**

| Party | Source of information used for this synthesis[a] | Years reported | Reporting on LUCF[b] | Reporting on agricultural soils |
|---|---|---|---|---|
| Australia | INV99 | 1990-1997 | Yes | Yes |
| Austria | INV99 | 1990-1997 | Yes | Yes |
| Belgium | INV99 | 1990-1997 | Yes | Yes |
| Bulgaria | INV99 | 1997 | Yes | Yes |
| Canada | INV99 | 1990-1997 | Yes | Yes |
| Czech Republic | INV99 | 1997 | Yes | Yes |
| Denmark | INV99 | 1997 | Yes | Yes |
| Estonia | INV99 | 1997 | Yes | Yes |
| Finland | INV99 | 1990, 1995-1997 | NR | Yes |
| France | INV99 | 1990-1997 | Yes | Yes |
| Germany | INV99 | 1990-1998[e] | Yes | Yes |
| Greece | INV99 | 1990-1997 | NR | Yes |
| Hungary | INV98 | 1991-1996 | Yes | Yes |
| Iceland | NC2 (1997) | 1991-1995 | NR | Yes |
| Ireland | INV98 | 1995-1996 | Yes | Yes |
| Italy | NC2 (1998) | 1990, 1994-1995 | Yes | Yes |
| Japan | INV99 | 1990-1997 | Yes[c] | Yes |
| Latvia | INV99 | 1997 | Yes | Yes |
| Liechtenstein | Report (1995) | 1990 | NR | NR |
| Lithuania | INV99 | 1995-1997 | Yes | -[d] |
| Luxembourg | INV 98 | 1990, 1994-1996 | Yes | Yes |
| Monaco | INV99 | 1990-1997 | NR | NR |
| Netherlands | INV98 | 1990-1996 | Yes | Yes |
| New Zealand | INV99 | 1997 | Yes | Yes |
| Norway | INV99 | 1990-1997 | Yes | Yes |
| Poland | INV99 | 1997 | Yes | Yes |
| Portugal | NC2 (1997) | 1990-1994 | Yes | Yes |
| Romania | NC2 (1998) | 1989-1994 | Yes | |
| Russian Federation | INV99 | 1995-1996 | Yes | Yes |
| Slovakia | 1NV98 | 1995-1996 | Yes | Yes |
| Slovenia | NC1 (1997) | 1990 | Yes | Yes |
| Spain | INV98 | 1990-1995 | NR | Yes |
| Sweden | INV99 | 1990, 1996-1997 | Yes | Yes |
| Switzerland | INV99 | 1997 | Yes | Yes |
| Ukraine | INV99 | 1990-1998[e] | Yes | |
| United Kingdom | INV99 | 1990-1997 | Yes | Yes |
| USA | INV99 | 1990-1997 | Yes | Yes |

[a] INV98 – inventory submission 1998; INV99 – inventory submission 1999; NC1 – first national communication; NC2 – second national communication. Years between brackets in this column indicate the year in which the NC or report was submitted.

[b] NR – Not reported. Whilst both Finland and Spain did not report on the LUCF sector in their latest annual inventories, both Parties reported on this sector in their national communications.

[c] Though the inventory primarily contained data for 1997, the $CO_2$ emissions for the LUCF sector were provided for 1995.

[d] From agriculture, forestry and land-use and wood stock change reported as aggregate sector. Sectoral tables were not provided.

[e] Whilst Germany and Ukraine reported inventory data for 1998, this information was not used in this synthesis report. Priority was given to using the same inventory year for as many Parties as possible.

## II. COMPLETENESS AND COMPARABILITY OF LATEST SUBMISSIONS OF ANNUAL INVENTORIES AND NATIONAL COMMUNICATIONS

10. The revised guidelines for the preparation of national communications by Parties included in Annex I to the Convention, request Parties to report inventories using the formats recommended in the IPCC Guidelines (see decision 9/CP.2 (FCCC/CP/1996/15/Add.1)), which include summary tables, sectoral tables, overview tables, and worksheets or equivalent information, including activity data and emission factors. The worksheets for LUCF and agricultural soils are explicitly requested. Up to the adoption of decision 3/CP.5 (FCCC/CP/1999/6/Add.1), no specific guidance existed on how annual inventories should be reported.[4] Consequently, an assessment of the completeness and comparability of reporting on the basis of, *inter alia*, the type of information contained in the GHG inventory submissions and national communications, should be considered with this limitation in mind. Table 2 summarizes information according to its type as submitted by Parties. Additional details are provided below.

Summary reports

11. Summary reports according to the IPCC format, incorporating both information on LUCF (category 5A to 5E) and agricultural soils (category 4D) were submitted by 34 Parties. Hungary, Liechtenstein and Ukraine did not provide the summary reports, and the summary reports submitted by Austria, Lithuania, Luxembourg, Romania and Slovenia did not follow the IPCC format.

Sectoral reports

12. The LUCF and agriculture sectoral reports (respectively tables 5 and 4 of the IPCC Guidelines) with information at the category level, were submitted by 21 Parties. Hungary, Portugal and Slovenia submitted sectoral information, but not according to the IPCC sectoral report format. Sectoral reports for agriculture, providing disaggregated data for agricultural soils (sub-module 4D), were submitted by all Parties that reported on agricultural soils.

Worksheets

13. Worksheets, providing activity data and emission factors for LUCF, were submitted by seven Parties (Australia, Hungary, Japan, Slovakia, Slovenia, Sweden and Switzerland), whilst worksheets for agricultural soils were submitted by four Parties (Australia, Hungary, Japan and Sweden).

Overview tables

14. Overview tables, according to the IPCC format for the LUCF sector, were provided by Australia, Bulgaria, Canada, Czech Republic, France, Italy, Japan, New Zealand, Russian Federation, Sweden, Switzerland, United Kingdom and the United States of America. Thirteen of these Parties provided an indication of the quality of the estimates. Thirteen Parties provided estimates for agricultural soils using overview tables.

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[4] The UNFCCC reporting guidelines for annual inventories of Annex I Parties were adopted by decision 3/CP.5. These guidelines explicitly request that emission factors and activity data be reported through the national inventory report and the common reporting format.

Activity data and emission factors

15. Australia, Bulgaria, Greece, Hungary, Japan, Portugal, Slovenia and Switzerland reported activity data for the LUCF sector. Except for Switzerland, the same countries reported activity data and emission factors for the agricultural soils category.

Notation keys

16. Notation keys indicate whether emissions or removals are not occurring (NO), not estimated (NE), not applicable (NA), or estimated but included elsewhere (IE). Notation keys are used by 12 Parties. In many instances Parties left cells empty or entered a 'zero', but it remains unclear whether in such cases no estimates have been made or whether emissions or removals are indeed "zero".

**Table 2: Reporting of summary and sectoral reports, worksheets, overview tables, activity data, and notations keys in the latest submissions from Annex I Parties**

| Country | Source[a] | Summary report | Sectoral report | Worksheets | Overview tables | Activity data | Notation keys |
|---|---|---|---|---|---|---|---|
| Australia | INV99 | Yes | Yes | Yes | Yes | Yes | Yes |
| Austria | INV99 | Yes[b] | No | No | No | No | No |
| Belgium | INV99 | Yes | Yes | No | No | No | No |
| Bulgaria | INV99 | Yes | Yes | No | Yes | Yes | No |
| Canada | INV99 | Yes | Yes | No | Yes | No | Yes |
| Czech Republic | INV99 | Yes | Yes | No | Yes | No | Yes |
| Denmark | INV99 | Yes | Yes | No | No | No | No |
| Estonia | INV99 | Yes | Yes | No | No | No | No |
| Finland[c] | INV99 | Yes | No | No | Yes | No | Yes |
| France | INV99 | Yes | Yes | No | Yes | No | No |
| Germany | INV99 | Yes | No | No | No | No | Yes |
| Greece | INV99 | Yes | Yes | No | No | Yes | No |
| Hungary | INV98 | No | Yes[b] | Yes | No | Yes | No |
| Iceland | NC2 | Yes | No | No | No | No | No |
| Ireland | INV98 | Yes | No | No | No | No | Yes |
| Italy | NC2 | Yes | No | No | Yes | No | No |
| Japan | INV99 | Yes | Yes | Yes | Yes | Yes | Yes |
| Latvia | INV99 | Yes | Yes | No | No | No | No |
| Liechtenstein | report | No | No | No | No | No | No |
| Lithuania | INV99 | Yes[b] | No | No | No | No | No |
| Luxembourg | Report | Yes | No | No | No | No | No |
| Monaco | INV99 | Yes | No | No | No | No | No |
| Netherlands | INV98 | Yes | No | No | No | No | No |
| New Zealand | INV99 | Yes | Yes | No | Yes | No | Yes |
| Norway | INV99 | Yes | Yes | No | Yes[d] | No | Yes |
| Poland | INV99 | Yes | No | No | No | No | No |
| Portugal | NC2 | Yes | Yes[b] | No | No | Yes | No |
| Romania | NC2 | Yes[b] | No | No | No | No | No |
| Russian Federation | INV99 | Yes | Yes | No | Yes | No | No |
| Slovakia | INV98 | Yes | No | Yes | No | No | No |
| Slovenia | NC1 | Yes[b] | Yes[b] | Yes | No | Yes | No |
| Spain[c] | INV98 | Yes | No | No | No | No | No |
| Sweden | INV99 | Yes | Yes | Yes | Yes | No | No |
| Switzerland | INV99 | Yes | Yes | Yes | Yes | Yes | Yes |
| Ukraine | INV99 | No | No | No | No | No | No |
| United Kingdom | INV99 | Yes | Yes | No | Yes | No | Yes |
| USA | INV99 | Yes | Yes | No | Yes | No | Yes |

[a] INV98 – inventory submission 1998; INV99 – inventory submission 1999; NC1 – first national communication; NC2 – second national communication.

[b] Summary reports are provided but not according to IPCC format.

[c] Whilst both Finland and Spain did not report on the LUCF sector in their latest annual inventories, both Parties reported on this sector in their national communications.

[d] Information provided in the overview table did not include LUCF.

## III. GREENHOUSE GAS EMISSIONS AND REMOVALS IN THE LUCF SECTOR

### A. Reporting on estimates of $CO_2$ emissions and removals

17. Thirty-one Parties reported carbon dioxide ($CO_2$) emissions and/or removals from the LUCF sector in their latest submissions.[5] Whilst all of these Parties except Lithuania reported $CO_2$ *removals*, less then half reported *emissions* (see table 3). One reason for this could be the footnote to table 5 (sectoral report on LUCF) and tables 7A and 7B (summary report and short summary report for GHG inventories) in volume 1 of the IPCC Guidelines, which requests Parties not to provide an estimate of both $CO_2$ emissions and $CO_2$ removals. Instead Parties are requested to provide an estimate of net $CO_2$ emissions[6] and to place a single number in either the $CO_2$ emissions or $CO_2$ removals column, as appropriate.

18. Six Parties (Finland, Greece, Iceland, Liechtenstein, Monaco and Spain) did not report $CO_2$ emissions or removals in their latest submissions, either by indicating the notation key NE (Finland), by entering "zero" in the relevant cells (Spain), or by not providing any values. For all reporting Parties the LUCF sector constitutes a net sink for $CO_2$ (emissions - removals), except for Australia, Estonia, Lithuania, and the United Kingdom (see figure 1).

19. Eleven Parties reported for all years from 1990 to 1997 (35 per cent of all Parties reporting on LUCF); Germany and Ukraine reported for the period 1990 to 1998. Bulgaria, the Czech Republic, Denmark, Estonia, Latvia, New Zealand, Poland and Switzerland reported only for 1997. Other Parties reported for different periods (see table 1).

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[5] Finland and Spain had reported on LUCF in previous submissions.

[6] The term "net emissions" is used in this note to refer to the arithmetic sum of $CO_2$ emissions and $CO_2$ removals in the LUCF sector or in a given category of this sector. This sum may be positive or negative, corresponding to net emissions or net removals.

**Table 3: GHG emissions and removals in the LUCF sector (Gg)[a]**

| Party | Year | $CO_2$ emissions | $CO_2$ Removals | $CH_4$ | $N_2O$ | $NO_x$ | CO | NMVOC | Aggregate GHG emissions from LUCF in $CO_2$ equivalent[b, e] |
|---|---|---|---|---|---|---|---|---|---|
| Australia | 1997 | 130 347 | 96 298 | 174.34 | 1.97 | 69.11 | 3 667.62 | NA | 38 321 |
| Austria | 1997 | | 13 753 | | | | | | -13 753 |
| Belgium | 1997 | | 2 057 | 5.07 | 3.26 | | | 29.29 | -940 |
| Bulgaria | 1997 | | 5 852 | | | | | | -5 852 |
| Canada | 1997 | | 19 000 | 40.00 | 2.80 | | | | -17 292 |
| Czech Republic | 1997 | | 4 639 | 2.25 | | 0.04 | 19.65 | | -4 591 |
| Denmark | 1997 | | 997 | | 0.49 | | | 9.01 | -845 |
| Estonia | 1997 | 12 639 | 4 646 | 0.01 | | | 0.08 | | 7 993 |
| Finland[c] | 1997 | NE | NE | | | | | | |
| France | 1997 | 89 615 | 157 387 | 100.62 | 17.98 | 2.75 | 96.79 | 400.35 | -60 085 |
| Germany | 1997 | | 33 493 | NO | NO | NO | NO | NO | -33 493 |
| Greece | 1997 | | | | | | | | |
| Hungary | 1996 | 1 490 | 5 421 | 0.30 | | 0.10 | 2.30 | | -3 925 |
| Iceland | 1995 | | | | | | | | |
| Ireland | 1996 | | 6 497 | 26.88 | 0.89 | | | | -5 657 |
| Italy | 1995 | 11 692 | 36 199 | 183.30 | 20.00 | 1.00 | 34.2 | 156.1 | -14 458 |
| Japan | 1995 | 942 | 97 648 | 4.00 | | 1.00 | 36.00 | 0.00 | -96 622 |
| Latvia | 1997 | 5 | 14 320 | | | | 0.02 | | -14 315 |
| Liechtenstein | 1990 | | | | | | | | |
| Lithuania[d] | 1997 | 2 800 | | | | | | | 2 800 |
| Luxembourg | 1996 | | 295 | | 0.034 | | | 0.835 | -284 |
| Monaco | 1997 | | | | | | | | |
| Netherlands | 1996 | | 1 700 | | | | | | -1 700 |
| New Zealand | 1997 | 1 889 | 18 897 | 6.64 | 0.05 | 1.65 | 58.08 | NE | -16 853 |
| Norway | 1997 | | 16 499 | | | | | | -16 499 |
| Poland | 1997 | 674 | 41 195 | 0.22 | 0.002 | | | | -40 516 |
| Portugal | 1994 | | 1 152 | NA | NA | NA | NA | NA | -1 152 |
| Romania | 1994 | | 6 590 | | | | | | -6 590 |
| Russian Federation | 1996 | | 840 000 | 400 | 3 | | | | -830 670 |
| Slovakia | 1996 | 760 | 6 041 | 1 | | | 13 | | -5 260 |
| Slovenia | 1990 | 3 610 | 5 904 | 0.61 | 0.004 | 0.15 | 5.35 | | -2 280 |
| Spain[c] | 1995 | | | | | | | | |
| Sweden | 1997 | | 31 774 | | | | | | -31 774 |
| Switzerland | 1997 | | 5 355 | | | | | | -5 355 |
| Ukraine | 1997 | | 68 806 | | | | | | -68 806 |
| United Kingdom | 1997 | 27 075 | 11 557 | | | | | | 15 518 |
| USA | 1997 | NA | 764 683 | NE | NE | NE | NE | NE | -764 683 |

Notation keys: NO: not occurring; NE: not estimated; NA: not applicable to source category.

[a] For the sake of consistency (see paragraph 16 above), where "0" was reported by a Party, the secretariat did not include it in this and the following tables.

[b] The totals may not tally due to rounding off to the nearest integer.

[c] Whilst both Finland and Spain did not report on the LUCF sector in their latest annual inventories, both Parties reported on this sector in their national communications.

[d] Sectoral tables not provided: the emissions from agriculture, forestry, land-use and wood stock change are reported together.

[e] $CH_4$ and $N_2O$ emissions are converted to $CO_2$ equivalent emissions by using the global warming potentials of 21 for $CH_4$, and 310 for $N_2O$ (Source: Second Assessment Report of the IPCC (1995)).

### B. Reporting on $CO_2$ emissions and removals for IPCC categories 5A to 5E in the LUCF sector

20. The IPCC Guidelines identify four sources and sinks in the land-use change and forestry sector, namely: 5A, changes in forest and other woody biomass stocks; 5B, forest and grassland conversion; 5C, abandonment of managed lands; and 5D, $CO_2$ emissions and removals from soil. Under category 5E, 'other' sources and/or sinks can be reported. The emissions and removals reported by Parties for these categories in their latest submissions are presented in table 4.

Changes in forest and other woody biomass stocks (5A)

21. The emissions and/or removals in the LUCF sector were reported by all the Parties reporting on this sector.[7] For 27 Parties, the removals of $CO_2$ by existing forests, plantations and non-forest trees (without changes in land-use) are larger than the emissions, making this category a net sink for the majority of Annex I Parties.

Forest and grassland conversion (5B)

22. $CO_2$ emissions due to forest and grassland conversion were reported by 11 Parties. $CO_2$ emissions were reported to be "not occurring" (NO) in the Czech Republic and Switzerland, and "not estimated" (NE) by Finland, Norway and the United States. It is not clear if emissions are not occurring or not estimated for many of the remaining Parties (see also table 4).

Abandonment of managed lands (5C)

23. $CO_2$ removals due to the abandonment of managed lands (croplands, pastures, plantation forests) where a regrowth of natural vegetation occurs, were estimated by six Parties. Seven Parties reported emissions or removals as either not estimated or not occurring. Switzerland included its removals in worksheet 5A, along with changes in forest and other woody biomass stocks.

$CO_2$ emissions and removals from soil (5D)

24. According to the IPCC Guidelines (Volume 3, Reference Manual, pp. 4.2, 4.87), $CO_2$ emissions from agricultural soils are to be included under LUCF. At the same time, table 7A (summary report for national GHG inventories in volume 1: IPCC Reporting Instructions) allows for reporting $CO_2$ emissions or removals from agricultural soils, either in the agriculture sector (under D: agricultural soils) or in the LUCF sector (under D: emissions and removals from soil).

25. $CO_2$ emissions from soils were reported by seven Parties, ranging from 23,409 Gg for the United Kingdom to 5 Gg for Latvia. Canada and Iceland reported $CO_2$ emissions from soils through the summary table of the agriculture sector (under category 4D: agricultural soils). $CO_2$ *removals* from soil were reported by Italy and Poland. The $CO_2$ emissions from soils are higher than the net $CO_2$ removals from the category 'changes in forest and other woody biomass stocks' for the United Kingdom (2.2 times) and Estonia (3.8 times).

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[7] However, Ukraine did not provide estimates according to the IPCC source/sink categories 5A to 5E.

Others (5E)

26. Canada and the United Kingdom reported other $CO_2$ emissions and only Australia reported other $CO_2$ removals. The management practices included are emissions from fires outside of wood production forests for Canada, emission from soils due to upland and lowland drainage, peat extraction and increases in crop biomass for the United Kingdom, and the net uptake from prescribed burning of forest and wildfires and pasture improvement and minimum tillage for Australia.

**Table 4: $CO_2$ emissions and removals according to different IPCC categories (Gg)**

| Party | Year | 5A[a] | 5B[a] | 5C[a] | 5D[a] | 5E[a,b] | Total $CO_2$ emissions and/or removals |
|---|---|---|---|---|---|---|---|
| Australia | 1997 | -23 673 | 61 946 | NE | NE | -4 224 | 34 050 |
| Austria | 1997 | -13 753 | | | | | -13 753 |
| Belgium | 1997 | -2 057 | | | | | -2 057 |
| Bulgaria | 1997 | -5 852 | | | | | -5 852 |
| Canada | 1997 | -30 000 | 4 000 | -4 000 | 5 000 | 6 000 | -19 000 |
| Czech Republic | 1997 | -4 639 | NO | NO | NE | | -4 639 |
| Denmark | 1997 | -997 | | | | | -997 |
| Estonia | 1997 | -3 386 | 18 | -1260 | 12 621 | | 7 993 |
| Finland[c] | 1997 | NE | NE | NE | NE | NE | |
| France | 1997 | -83 365 | 12 343 | -48 | 3 298 | 0 | -67 772 |
| Germany | 1997 | -33 493 | NE | NE | NE | NE | -33 493 |
| Greece | 1997 | | | | | | |
| Hungary | 1996 | -5 421 | 1 490 | | | | -3 931 |
| Iceland | 1995 | | | | | | |
| Ireland | 1996 | -6 497 | | | | | -6 497 |
| Italy | 1995 | -25 304 | 811 | -157 | -95 | | -24 507 |
| Japan | 1995 | -97 648 | 942 | | | | -96 706 |
| Latvia | 1997 | -14 320 | | | 5 | | -14 315 |
| Liechtenstein | 1990 | | | | | | |
| Lithuania | 1997 | 2 800 | | | | | 2 800 |
| Luxembourg | 1995 | -295 | | | | | -295 |
| Monaco | 1997 | | | | | | |
| Netherlands | 1996 | -1 700 | | | | | -1 700 |
| New Zealand | 1997 | -18 897 | 1 889 | NE | NE | | -17 008 |
| Norway | 1997 | -16 499 | NE | NE | NE | NE | -16 499 |
| Poland | 1997 | -29 880 | 101 | -7 905 | -2 836 | | -40 521 |
| Portugal | 1994 | -1 152 | | | | | -1 152 |
| Romania | 1994 | -6 590 | | | | | -6 590 |
| Russian Federation | 1996 | -840 000 | | | | | -840 000 |
| Slovakia | 1996 | -6 041 | 760 | | | | -5 281 |
| Slovenia | 1990 | -3 072 | 1 480 | -702 | | | -2 294 |
| Spain[c] | 1995 | | | | | | |
| Sweden | 1997 | -31 774 | | | | | -31 774 |
| Switzerland | 1997 | -5 355 | NO | IE | NE | | -5 355 |
| Ukraine | 1997 | | | | | | -68 806 |
| United Kingdom | 1997 | -10 457 | | | 23 409 | 2 567 | 15 518 |
| United States of America | 1997 | -764 683 | NE | NE | NE | NA | -764 683 |
| Number of Parties reporting | | 30 | 11 | 6 | 7 | 3 | |
| Percentage of Parties reporting (%) | | 100 | 37 | 20 | 23 | 10 | |

Notation keys: NO: not occuring; IE: estimated but included elsewhere; NE: not estimated; and NA: not applicable.

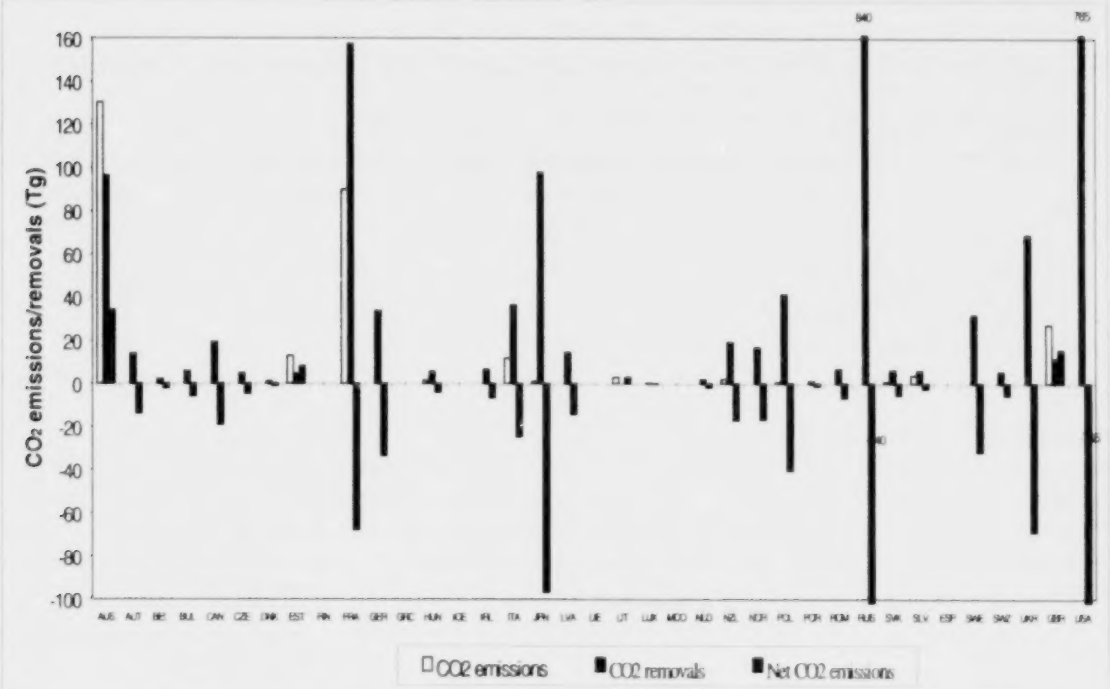
[a] The categories are: 5A – changes in forest and other woody biomass stocks; 5B – forest and grassland conversion; 5C – abandonment of managed lands; 5D – $CO_2$ emissions and removals from soil; 5E – others.

[b] For 5E (others) Parties reported as follows:

- Australia = prescribed burning of forests and wildfire; pasture improvement and minimum tillage;
- Canada = fires outside of wood production forests;
- United Kingdom = emissions from soils due to upland and lowland drainage and peat extraction and increases in crop biomass.

[c] Whilst both Finland and Spain did not report on the LUCF sector in their latest annual inventories, both Parties reported on this sector in their national communications.

**Fig 1: $CO_2$ emissions, removals and net emissions from the LUCF sector**




*Note*: Values for $CO_2$ emissions and removals are taken from table 3. The net emissions are estimated by taking the net value ($CO_2$ emissions – $CO_2$ removals).

## C. $CH_4$, $N_2O$, and other non-$CO_2$ greenhouse gases in the LUCF sector[8]

27. $CO_2$ equivalent emissions for methane ($CH_4$) and nitrous oxide ($N_2O$) are to be calculated using the global warming potentials (GWP) provided by the IPCC in its Second Assessment Report ("1995 IPCC GWP values"[9]) based on the effects of the greenhouse gases over a 100-year time horizon. $N_2O$ was reported by 11 Parties, compared to 15 Parties reporting $CH_4$. The percentage share of $CH_4$ and $N_2O$ in $CO_2$ equivalent emissions is presented in table 5 for those 15 Parties.

28. The $CH_4$ and $N_2O$ emissions in $CO_2$ equivalent accounted for approximately 35 per cent of the aggregate GHG emissions in the LUCF sector for Belgium, and between approximately 8 and 17 per cent for Canada, Denmark, Ireland and Italy. For all other Parties the share was less then 3 per cent (see table 5).

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[8] According to the IPCC Guidelines, $CH_4$ and $N_2O$ emissions resulting from burning forests and/or grasslands are to be estimated and reported. The IPCC provides default methods to estimate all the non-$CO_2$ GHG emissions ($CH_4$, $N_2O$, $NO_X$, CO and NMVOC) based on the $CO_2$ emission estimates resulting from burning forests and/or grasslands.

[9] $CH_4$ and $N_2O$ emissions are converted to $CO_2$ equivalent emissions by using the global warming potentials of 21 for $CH_4$, and 310 for $N_2O$ (Source: Second Assessment Report of the IPCC (1995)).

29. The total emissions for the LUCF sector in $CO_2$ equivalent are provided in table 3. Considering all the GHGs, the LUCF sector is a net source of emissions for Australia, Estonia, Lithuania, and the United Kingdom.

**Table 5: Share of $CH_4$ and $N_2O$ in the total aggregate LUCF emissions and/or removals**

| Party | Year | $CO_2$ emissions [Gg] | $CO_2$ removals [Gg] | Net $CO_2$ emissions /removals [Gg] [c] | $CH_4$ [Gg] | $N_2O$ [Gg] | Total $CO_2$ equivalent emissions [a] [Gg] [c] | Share of $CH_4$ and $N_2O$ in the aggregate GHG emissions of the LUCF sector [b] (percentage) |
|---|---|---|---|---|---|---|---|---|
| Australia | 1997 | 130 347 | 96 298 | 34 049 | 174.34 | 1.97 | 38 321 | 1.9 |
| Belgium | 1997 | | 2 057 | -2 057 | 5.07 | 3.26 | -940 | 35.2 |
| Canada | 1997 | | 19 000 | -19 000 | 40.00 | 2.80 | -17 292 | 8.2 |
| Czech Republic | 1997 | | 4 639 | -4 639 | 2.25 | | -4 592 | 1.0 |
| Denmark | 1997 | | 997 | -997 | | 0.49 | -845 | 13.2 |
| Estonia | 1997 | 12 639 | 4 646 | 7 993 | 0.01 | | 7 993 | 0.003 |
| France | 1997 | 89 615 | 157 387 | -67 772 | 100.62 | 17.98 | -60 085 | 3.0 |
| Hungary | 1996 | 1 490 | 5 421 | -3 931 | 0.30 | | -3 925 | 0.1 |
| Ireland | 1996 | | 6 497 | -6 497 | 26.88 | 0.89 | -5 657 | 11.5 |
| Italy | 1995 | 11 692 | 36 199 | -24 507 | 183.30 | 20.00 | -14 458 | 17.3 |
| Japan | 1995 | 942 | 97 648 | -96 706 | 4.00 | | -96 622 | 0.1 |
| New Zealand | 1997 | 1 889 | 18 897 | -17 008 | 6.64 | 0.05 | -16 853 | 0.7 |
| Poland | 1997 | 674 | 41 195 | -40 521 | 0.22 | 0.002 | -40 516 | |
| Russian Federation | 1996 | | 840 000 | -840 000 | 400 | 3 | -830 670 | 1.1 |
| Slovakia | 1996 | 760 | 6 041 | -5 281 | 1 | | -5 260 | 0.3 |
| Slovenia | 1990 | 3 610 | 5 904 | -2 294 | 0.61 | 0.004 | -2 280 | 0.1 |

[a] To calculate total $CO_2$ equivalent emissions for the LUCF sector the 1995 IPCC GWP values were used.

[b] The share of $CH_4$ and $N_2O$ was calculated as follows: $[(CH_4 \times 21) + (N_2O \times 310)] \times 100 / (CO_2$ emissions + $CO_2$ removals + $(CH_4 \times 21)$ emissions + $(N_2O \times 310)$ emissions).

[c] Negative values indicate a removal of $CO_2$, positive values indicate a net source of emissions.

30. Among the precursors of GHGs, carbon monoxide (CO) is reported by 11 Parties, nitrogen oxides ($NO_x$) by eight, and non-methane volatile organic compounds (NMVOC) by five Parties. Although not mandatory, it is not clear why some Parties only reported one, or a selection of non-$CO_2$ GHGs, since the IPCC Guidelines provide default methods to estimate emissions of all GHGs on the basis of $CO_2$ emissions from particular categories. Australia, France, Italy, New Zealand, and Slovenia reported for nearly all the gases. USA reported that all non-$CO_2$ gases are "not estimated", Portugal that all these gases are "not applicable", and Germany reported these gases as "not occurring" (see also table 3).

### D. Comparison of the LUCF sector with other sectors and national emissions

31. The net $CO_2$ emissions from the LUCF sector and the total $CO_2$ emissions from all other sectors (including and excluding LUCF) are shown in figure 2a. Figure 2b shows the aggregate GHG emissions and/or removals from the LUCF sector and the aggregate GHG emissions from all other sectors (including and excluding LUCF). Table 6 presents the values for the total $CO_2$ emissions, including and excluding LUCF, and aggregate GHG emissions in $CO_2$ equivalent, including and excluding LUCF.

32. For Australia, Estonia, Lithuania, and the United Kingdom, the LUCF sector is a net source of emissions, both of $CO_2$ and of all GHGs. In the case of Latvia, the LUCF sector is a sink. The LUCF sector partially offsets the $CO_2$ emissions from other sectors for 27 Parties. It reduces $CO_2$ emissions from other sectors by over 10 per cent for 13 Parties, and by over 50 per cent for four of these Parties.

33. There is no single year for which all the Annex I Parties reported $CO_2$ emissions from the LUCF sector. The total $CO_2$ removals for all Parties in the LUCF sector for the latest year reported are 2,035 Tg. In comparison, the total $CO_2$ emissions from all other sectors (excluding LUCF) is estimated to be 13,578 Tg, indicating that the LUCF sector offsets the total $CO_2$ emissions of all Annex I Parties by approximately 15 per cent. Considering aggregate GHG in $CO_2$ equivalent, the LUCF sector offsets approximately 12 per cent of the aggregate GHG emissions (excluding LUCF). More detail is provided in table 6.

**Fig 2a: Net $CO_2$ emissions from the LUCF sector and total $CO_2$ emissions from all other sectors (including and excluding LUCF).**

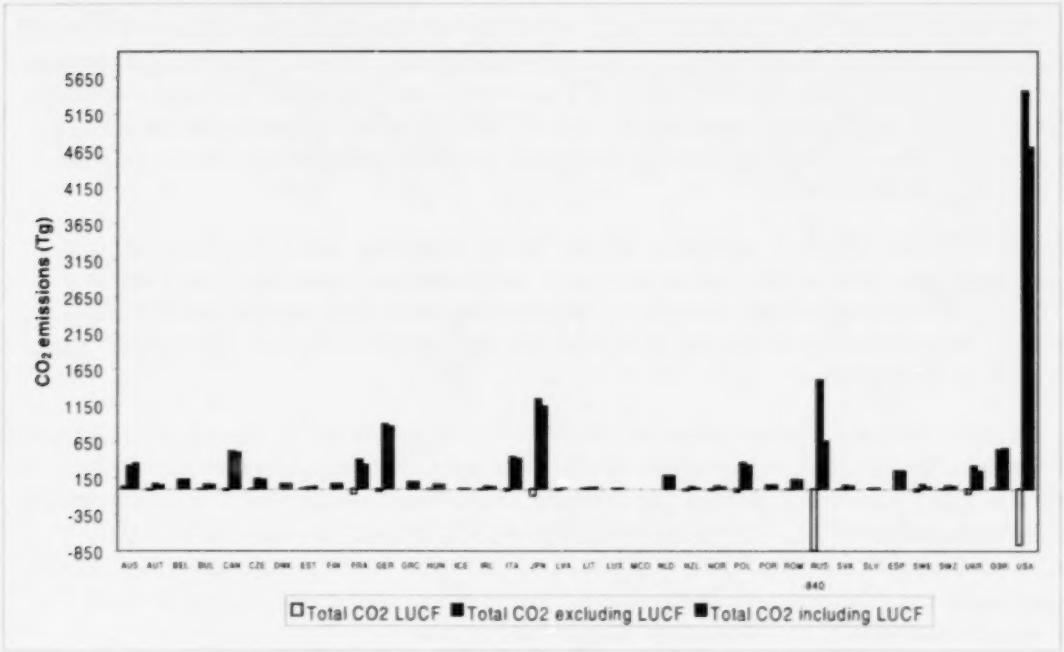
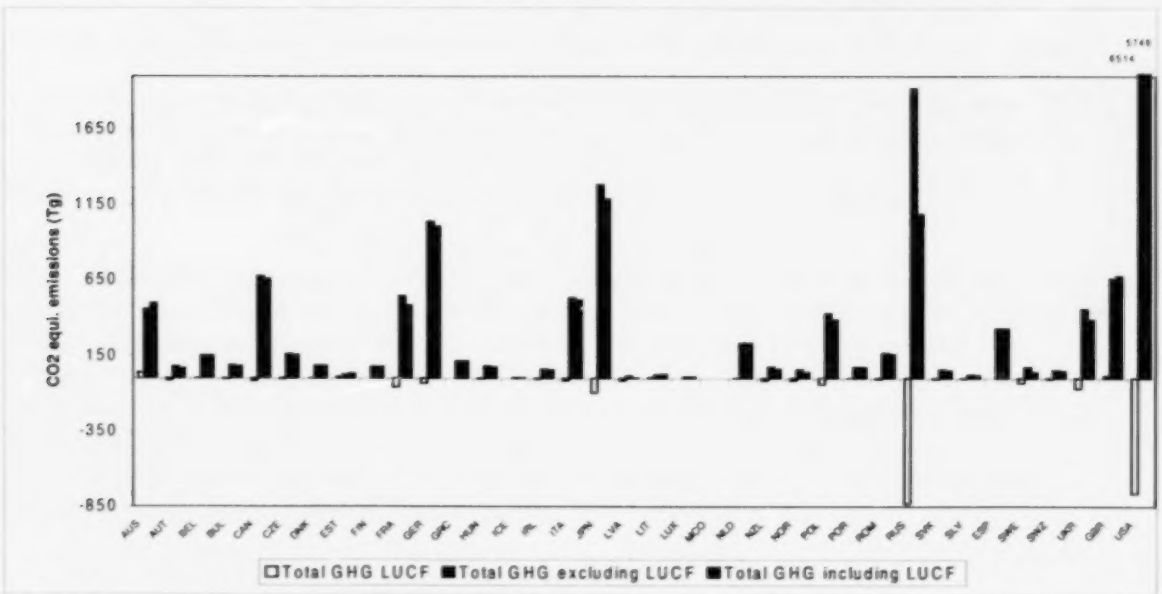



**Fig 2b: Aggregate GHG emissions and/or removals from the LUCF sector and aggregate GHG emissions from all other sectors (including and excluding LUCF)**




*Note*: The data for these tables may be found in table 6.

**Table 6: National total $CO_2$ emissions and aggregate GHG emissions in $CO_2$ equivalent of all sectors (including and excluding LUCF)**

| Party | Inventory year | LUCF net $CO_2$ emissions [Gg] | Total $CO_2$ excluding LUCF [Gg] | Total $CO_2$ including LUCF [Gg] | Percentage increase or decrease in total $CO_2$ emissions with the inclusion of LUCF [a, c] | Aggregate GHG in the LUCF sector [Gg] | Aggregate GHG from all sectors excluding LUCF [Gg] | Aggregate GHG from all sectors including LUCF [Gg] | Percentage increase or decrease in total GHG emissions with the inclusion of LUCF [c] |
|---|---|---|---|---|---|---|---|---|---|
| Australia | 1997 | 34 050 | 315 353 | 349 403 | 10.8 | 38 321 | 456 508 | 494 829 | 8.4 |
| Austria | 1997 | -13 753 | 66 062 | 52 309 | -20.8 | -13 753 | 77 571 | 63 818 | -17.7 |
| Belgium | 1997 | -2 057 | 126 288 | 124 231 | -1.6 | -940 | 148 795 | 147 856 | -0.6 |
| Bulgaria | 1997 | -5 852 | 59 148 | 53 296 | -9.9 | -5 852 | 84 461 | 78 609 | -6.9 |
| Canada | 1997 | -19 000 | 519 280 | 500 280 | -3.7 | -17 230 | 672 910 | 655 680 | -2.6 |
| Czech Republic | 1997 | -4 639 | 137 125 | 132 486 | -3.4 | -4 591 | 157 768 | 153 177 | -2.9 |
| Denmark | 1997 | -997 | 64 322 | 63 325 | -1.6 | -845 | 83 351 | 82 506 | -1.0 |
| Estonia | 1997 | 7 993 | 20 716 | 28 708 | 38.6 | 7 993 | 23 097 | 31 090 | 34.6 |
| Finland | 1997 | | 64 600 | 64 600 | | | 76 184 | 76 184 | |
| France | 1997 | -67 772 | 402 237 | 334 465 | -16.8 | -60 085 | 542 652 | 482 567 | -11.1 |
| Germany | 1997 | -33 493 | 894 000 | 860 507 | -3.7 | -33 493 | 1035 804 | 1002 311 | -3.2 |
| Greece | 1997 | | 95 410 | 95 410 | | | 114 719 | 114 719 | |
| Hungary | 1996 | -3 931 | 60 475 | 56 545 | -6.5 | -3 925 | 79 124 | 75 199 | -5.0 |
| Iceland | 1995 | | 2 282 | 2 282 | | | 2 692 | 2 692 | |
| Ireland | 1996 | -6 497 | 34 819 | 28 322 | -18.7 | -5 657 | 58 882 | 53 225 | -9.6 |
| Italy | 1995 | -24 745 | 438 490 | 413 745 | -5.6 | -14 417 | 531 985 | 517 569 | -2.7 |
| Japan | 1997 | -96 705 | 1230 831 | 1134 126 | -7.9 | -96 610 | 1280 270 | 1183 660 | -7.5 |
| Latvia | 1997 | -14 315 | 12 842 | -1 473 | -111.5 | -14 315 | 15 959 | 1 643 | -89.7 |
| Lithuania | 1997 | 2 800 | 16 200 | 19 000 | 17.3 | 2 800 | 22 542 | 25 342 | 12.4 |
| Luxembourg | 1995 | -295 | 9 545 | 9 250 | -3.1 | -284 | 10 212 | 9 928 | -2.8 |
| Monaco | 1997 | | 143 | 143 | | | 147 | 147 | |

**Table 6 *(continued)*:**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Netherlands | 1996 | -1 700 | 184 870 | 183 170 | -0.9 | -1 700 | 232 071 | 230371 | -0.7 |
| New Zealand | 1997 | -17 008 | 30 284 | 13 276 | -56.2 | -16 855 | 75 235 | 58380 | -22.4 |
| Norway | 1997 | -16 499 | 41 430 | 24 931 | -39.8 | -16 499 | 53 740 | 37241 | -30.7 |
| Poland | 1997 | -40 521 | 361 626 | 321 105 | -11.2 | -40 516 | 426 215 | 385699 | -9.5 |
| Portugal | 1994 | -1 152 | 50 841 | 49 689 | -2.3 | -1 152 | 72 579 | 71427 | -1.6 |
| Romania | 1994 | -6 590 | 125 597 | 119 007 | -5.2 | -6 590 | 164 026 | 157436 | -4.0 |
| Russian Federation | 1996 | -840 000 | 1495 920 | 655 920 | -56.2 | -830 670 | 1916 934 | 1086264 | -43.3 |
| Slovakia | 1996 | -5 281 | 46 105 | 40 824 | -11.5 | -5 260 | 55 127 | 49867 | -9.5 |
| Slovenia | 1990 | -2 293 | 13 935 | 11 642 | -16.5 | -2 279 | 19 198 | 16919 | -11.9 |
| Spain | 1995 | | 247 703 | 247 703 | | | 325 530 | 325530 | 0.0 |
| Sweden | 1997 | -31 774 | 56 428 | 24 654 | -56.3 | -31 774 | 69 328 | 37554 | -45.8 |
| Switzerland | 1997 | -5 400 | 43 370 | 37 970 | -12.5 | -5 400 | 51 701 | 46301 | -10.4 |
| Ukraine | 1998 | -68 708 | 314 445 | 245 737 | -21.9 | -68 708 | 454 934 | 386225 | -15.1 |
| United Kingdom | 1997 | 15 518 | 540 643 | 556 161 | 2.9 | 15 518 | 657 435 | 672953 | 2.4 |
| USA | 1997 | -764 683 | 5455 553 | 4690 870 | -14.0 | -764 683 | 6513 874 | 5749191 | -11.7 |
| **Total** | | **-2 035 301** | **13 578 920** | **11 543 618** | **-15** | **-1 999 452** | **16 563 558** | **14 564 105** | **-12** |

*Note*: All figures in this table are rounded off to the nearest integer.

[a] Calculated as follows: (LUCF net $CO_2$ emissions) / (total $CO_2$ emissions excluding LUCF) x 100.

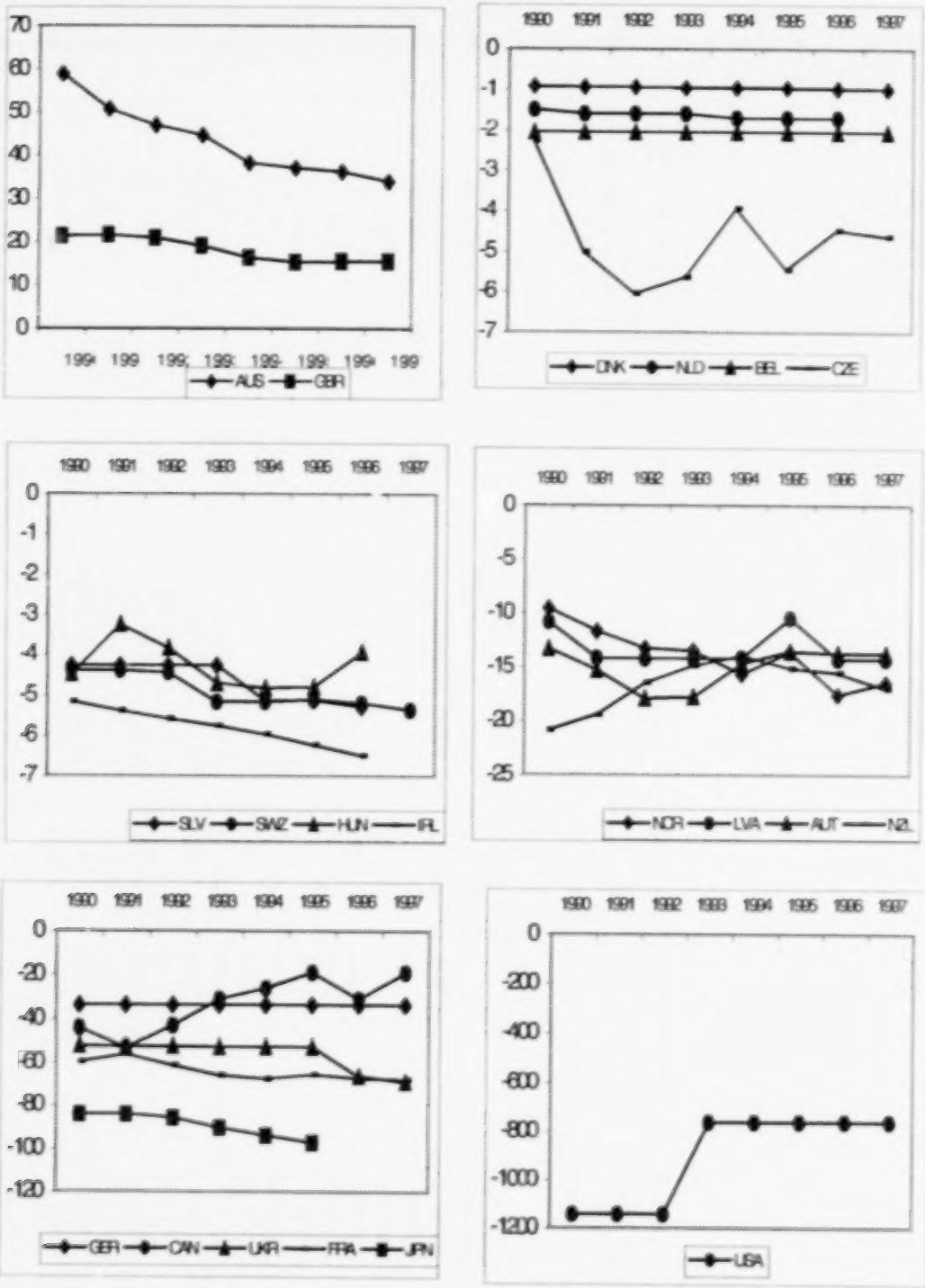
[b] The total $CO_2$ and $CO_2$ equivalent emissions from all sectors include data on the LUCF sector for the years 1995 and 1997 for the remaining sectors. Therefore, these totals may deviate from the national emissions reported for 1997 in the 1999 annual inventories.

[c] Negative values in percentages indicate a decrease in total emissions whilst positive values in percentage indicate an increase.

## E. $CO_2$ emission trends in the LUCF sector during the period 1990 to 1997

34. Not all Parties reported $CO_2$ emissions and removals for all years between 1990 and 1997. Data for a selection of Parties are presented in figure 3. These data indicate that for some Parties, the LUCF sector is removing GHGs from the atmosphere, but at a decreasing rate. For other Parties the reverse is occurring: the removal capacity of the LUCF sector is increasing. Estonia and Lithuania have changed during this period from being a net sink to being a net source, whilst in other countries the sink capacity of the LUCF sector has been reasonably stable (see also appendix I).

**Figure 3. Trends in $CO_2$ emissions and removals in the LUCF sector in selected Annex I Parties, 1990 - 1997 (Tg)**



## IV. GREENHOUSE GAS EMISSIONS AND REMOVALS IN THE AGRICULTURAL SOILS CATEGORIES

35. The main gas reported in this category is $N_2O$. Emissions of this GHG were reported by 32 Parties. Seven Parties also reported emissions of $CH_4$.[10] Two Parties reported emissions of $CO_2$. Only one Party reported removals in this category, namely of $CH_4$.

36. According to the IPCC Guidelines (Volume 3. Reference Manual, pp. 4.2, 4.87), $CO_2$ emissions from agricultural soils are to be included under LUCF. Hence, the IPCC reporting guidelines do not facilitate the reporting of $CO_2$ emissions and/or removals in the *sectoral* tables (table 4: sectoral report for agriculture) under the agricultural soils category 4D. At the same time, table 7A (summary report for national GHG inventories in volume 1: IPCC Reporting Instructions) allows for reporting $CO_2$ emissions or removals from agricultural soils, either in the agriculture sector (under D: agricultural soils) or in the LUCF sector (under D: emissions and removals from soil). This section of the report only focuses on the emissions and/or removals reported under category 4D: agricultural soils.

37. All Parties, except for Liechtenstein, Lithuania, Monaco, Romania and Ukraine, reported emissions and removals from agricultural soils for some years. Liechtenstein and Monaco did not report on emissions, while Romania and Ukraine did not provide sectoral or summary reports (tables 1 and 7 and appendix II).

38. $CO_2$ emissions from agricultural soils were only reported by Canada and Iceland. Emissions of $N_2O$ from agricultural soils were reported by 32 Parties although not for all years, whereas data on $CH_4$ were provided by seven Parties. Only Switzerland reported a *removal* for $CH_4$ due to soil oxidation.

39. $N_2O$ is the dominant GHG in the agricultural soils category for the majority of Parties. It accounts for 100 per cent of the $CO_2$ equivalent emissions for 71 per cent of all Parties that reported on agricultural soils, and from 90 to 100 per cent for an additional 19 per cent of the Parties.

40. Sixteen Parties reported $N_2O$ emissions for every year from 1990 to 1997, but in different submissions. All other Parties did not report consistently for all years. In order to obtain an approximate estimate of the importance of this gas, the $N_2O$ emissions for the latest years reported were aggregated. The aggregate $N_2O$ emission is estimated to be 1,832 Gg, or 567,985 Gg $CO_2$ equivalent.

41. $N_2O$ emission trends for the period 1990-1997 for selected countries are presented in figure 4 (and supporting data are presented in appendix II).

42. Emissions from the agricultural soils category are decreasing in some countries and increasing in others. These emissions fluctuate substantially in some countries. None of the Parties reported data indicating a net sink in this source category (see figure 4 and appendix II). Canada and Norway reported the same value for all the reported years.

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[10] The seven Parties that reported $CH_4$ all use CORINAIR to prepare their national inventories. Whilst the 1990 version of CORINAIR provided emission factors for $CH_4$ emissions from agricultural soils, the new version does not.

**Table 7: $CO_2$, $CH_4$ and $N_2O$ emissions from agricultural soils (Gg)**

| Party | Year | $CO_2$ emissions [Gg] | $CH_4$ [Gg] | $N_2O$ [Gg] | $NO_x$ [Gg] | NMVOC [Gg] | $CO_2$ equivalent emissions [a] [Gg] | Share of $N_2O$ in aggregate emissions of agricultural soils [both in $CO_2$ equivalent] |
|---|---|---|---|---|---|---|---|---|
| Australia | 1997 | | NA | 49.83 | NA | NA | 15 447 | 100 |
| Austria | 1997 | | 34.97 | 3.26 | 6.07 | 2.18 | 1 745 | 58 |
| Belgium | 1997 | | 14.39 | 9.36 | | 1.09 | 3 204 | 91 |
| Bulgaria | 1997 | | | 2.46 | | | 763 | 100 |
| Canada | 1997 | 1 000.00 | NA | 100.00 | | | 32 000 | 97 |
| Czech Republic | 1997 | NE | NE | 11.31 | NE | | 3 506 | 100 |
| Denmark | 1997 | | | 24.05 | | 1.27 | 7 456 | 100 |
| Estonia | 1997 | | | 0.03 | | | 9 | 100 |
| Finland | 1997 | NE | | 8.80 | | | 2 728 | 100 |
| France | 1997 | | 22.98 | 167.62 | 0.00 | 20.37 | 52 445 | 99 |
| Germany | 1997 | NO | NE | 76.00 | NO | NO | 23 560 | 100 |
| Greece | 1997 | | 99.30 | 19.60 | | 30.70 | 8 161 | 74 |
| Hungary | 1996 | | | 1.68 | | | 521 | 100 |
| Iceland | 1995 | 4.5 | | 0.50 | | | 160 | 97 |
| Ireland | 1996 | | 29.34 | 18.98 | | | 6 500 | 91 |
| Italy | 1995 | | | 63.50 | | | 19 685 | 100 |
| Japan | 1997 | | | 1.04 | | | 310 | 100 |
| Latvia | 1997 | | | 3.13 | | | 970 | 100 |
| Liechtenstein | 1990 | | | | | | | |
| Lithuania | 1997 | | | | | | | |
| Luxembourg | 1996 | | | 0.48 | | 0.162 | 149 | 100 |
| Monaco | 1997 | | | | | | | |
| Netherlands | 1996 | | | 26.70 | | 0.20 | 8 277 | 100 |
| New Zealand | 1997 | | | 36.10 | | | 11 191 | 100 |
| Norway | 1997 | NO | NO | 4.00 | NO | NO | 1 240 | 100 |
| Poland | 1997 | | | 31.15 | | 33.90 | 9 657 | 100 |
| Portugal | 1994 | NA | NE | 7.16 | NE | NE | 2 220 | 100 |
| Romania | 1994 | | | | | | | |
| Russian Federation | 1996 | | | 105.00 | | | 32 550 | 100 |
| Slovakia | 1996 | | | 5.50 | | | 1 705 | 100 |
| Slovenia | 1990 | | | 4.57 | | | 1 417 | 100 |
| Spain | 1995 | | 78.77 | 58.38 | | 71.22 | 19 752 | 92 |
| Sweden | 1997 | | | 14.00 | | | 4 340 | 100 |
| Switzerland | 1997 | | -3.20[b] | 8.50 | | | 2 568 | 103 |
| Ukraine | 1997 | | | | | | | |
| United Kingdom | 1997 | | NE | 93.87 | NE | NO | 29 100 | 100 |
| USA | 1997 | NE | NE | 876.17 | NE | NE | 271 613 | 100 |
| **Total** | | 1 004.9 | 276.55 | 1 832.21 | 6.07 | 160.93 | 574 800 | |

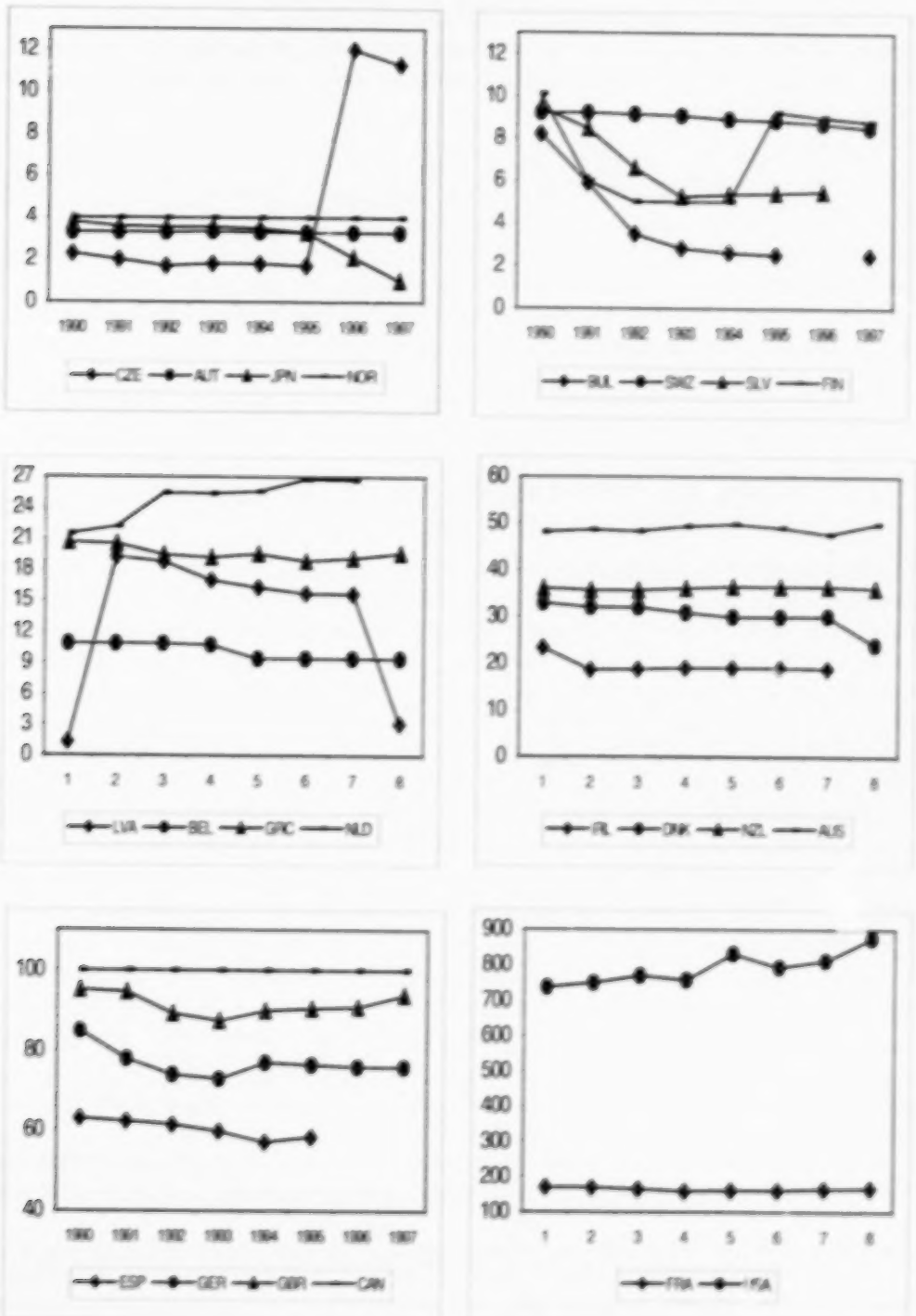
*Notes:*

Notation keys: NO: not occuring; NE: not estimated; NA: not applicable to source category
The emissions are as reported in the summary table of the respective parties. Empty cells or notation keys are reflected as reported.

[a] 1995 IPCC global warming potential values were used to convert $CH_4$ and $N_2O$ emissions into $CO_2$ equivalent emissions: 21 and 310 respectively.

[b] $CH_4$ removal for Switzerland due to $CH_4$ oxidation from agricultural soils.

**Figure 4. Trends in $N_20$ emissions in the agricultural soils category in selected Annex I Parties, 1990 - 1997 (Gg)**



## V. BASE YEAR EMISSION AND REMOVAL ESTIMATES AND THEIR RECALCULATION

### A. Base year emission and/or removal estimates as of the first national communications

43. In their first NCs, 29 Parties provided $CO_2$ estimates of emissions and/or removals from LUCF for the base year. Eight Parties (Austria, Canada, Greece, Iceland, Ireland, Luxembourg, Monaco and Romania)[11] did not provide estimates. According to the first NCs, estimated total net $CO_2$ emissions from the LUCF sector in 1990 amounted to approximately - 1,374,000 Gg for all Annex I Parties together.

44. Base year $N_2O$ emissions from the agricultural soils category were reported by 32 Parties in their first NC. However, in some cases only an aggregate $N_2O$ estimate for the agricultural sector as a whole was provided and reference to the agricultural soils source category was only made in the respective texts of the NCs. Five Parties (Liechtenstein, Luxembourg, Monaco, Romania and Russian Federation) did not provide estimates for this source category.[12] According to the first NCs, total $N_2O$ emissions from agricultural soils from all reporting Annex I Parties amounted to approximately 790 Gg in 1990.

45. Estimates for $CO_2$ emissions from agricultural soils were reported by Iceland (4.5 Gg) and Norway (200 Gg) in their first NCs.

### B. Base year emission and/or removal estimates as of the latest annual inventory submissions

46. The latest base year estimates for LUCF and agricultural soils were taken from the annual GHG inventories submitted in 1999, or, where not available, from the inventories submitted in 1998 (see table 1). However, for consideration of base year estimates it was necessary to use the second NCs for approximately half of the Parties, as the latest annual inventory submissions did not include base year estimates.[13] For the LUCF sector no base year estimates are available for three Parties (Greece, Iceland and Monaco)[14]. For four Parties (Hungary, Liechtenstein, Lithuania, and Slovenia) base year estimates for LUCF are as of first NCs. For the agricultural soils category, no base year estimates are available for three Parties (Liechtenstein, Monaco and Russian Federation), and for another four Parties (Hungary, Lithuania, Slovenia and Ukraine)[15] the latest base year estimates are from the first NCs. Total net $CO_2$ emissions for all Annex I Parties amounted to approximately -1,966,000 Gg $CO_2$ in 1990 according to the latest estimates available. Total $N_2O$ emissions from agricultural soils amounted to approximately 1,713 Gg $N_2O$ in 1990.

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[11] However, Greece provided an estimate of -4,200 Gg $CO_2$ in its first NC which was based on average activity data gathered during several decades prior to 1990, and Luxembourg provided an estimate of 105 Gg $CO_2$ from nature according to the CORINAIR methodology. Ireland reported "zero".

[12] Liechtenstein, Luxembourg and the Russian Federation reported $N_2O$ emissions from agriculture as a whole.

[13] Parties for which the latest base year estimates are available from the second NCs are given in *italics* in tables 8 and 9.

[14] Iceland reported its 1991 net emissions instead of reporting 1990 estimates. Greece placed the number "zero" in its IPCC tables and Monaco reported that methodologies available are not applicable to their national conditions.

[15] Hungary stated it has the same base year emissions as given in its first NC. The Russian Federation reported emissions from agricultural soils together with $N_2O$ emissions from animal waste.

47. $CO_2$ emissions from soils were included in the agricultural soils category by Canada in the latest inventory submission and by Iceland in the second NC. For Canada, this was not the case for the first NC[16]. All the other Parties reported $CO_2$ emissions from soils under the LUCF sector, if estimated.

## C. Recalculation of base year estimates

48. Information related to recalculation of base year estimates is provided in this paper to illustrate the magnitude of the changes in the estimates that have taken place since the first NCs. Base year inventories are recalculated under the current practice of inventory preparation as Parties seek to improve the quality and accuracy of their inventories when new inventory information becomes available.[17] These changes in estimates arise from the fact that Parties changed methods, emission factors, assumptions and activity data and/or added new sources. In addition, changes in base year estimates were due to the fact that the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories were applied.

49. In their first NCs, 29 Parties provided estimates of emissions and/or removals from LUCF for the base year. Of these, 20 Parties revised their estimates in their second NC and/or latest annual inventory submission. The magnitude of changes in LUCF base year estimates between the first NCs and the latest inventory available is shown in table 8. Nine Parties reported larger removals after base year inventory recalculation, the largest increase in removals being reported by the Netherlands, whose removals according to the latest estimates were more than 12 times higher than those reported in the first NC (1,150 per cent). For the remaining 11 Parties, recalculation of base year estimates led to estimates up to 80 per cent lower in the latest inventory compared to estimates from the first NCs. The United Kingdom is the only Party for which LUCF constituted a net sink according to the first NC and a net source of emissions in more recent inventories. This was mainly due to the inclusion of additional sources of emissions in the LUCF inventory.

50. $N_2O$ emission estimates from agricultural soils were recalculated by 26 Parties. The magnitude of changes in estimates between the first NCs and the latest inventory available is shown in table 9. Seventeen Parties revised their base year $N_2O$ estimates upwards, the largest change being reported by the United Kingdom, whose estimates according to the latest inventory were more than 23 times higher than those reported in the first NC (2,277 per cent).

51. Changes in $N_2O$ emissions leading to 10-fold increases or more were also noted for Canada and Latvia. In the case of Canada this was attributed to the inclusion of more sources of nitrogen: in previous inventories only nitrogen from synthetic fertilizer was considered. In most cases, changes in the emissions from agricultural soils could be attributed to the use of the Revised 1996 IPCC Guidelines, which included additional sources. Eight Parties revised their estimates downwards, by amounts ranging between 3 per cent and 66 per cent.

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[16] Canada started to report on $CO_2$ emissions from agricultural soils as of its second NC.

[17] Information on base year inventory recalculation from sectors other than land-use change and forestry can be found in working paper no 6 "Effects of recalculations of greenhouse gas inventories on assigned amounts and on emission limitation and reduction commitments of Annex I Parties", which was prepared for the workshop on issues related to Articles 5, 7 and 8 of the Kyoto Protocol held in Bonn from 14 to 16 March 2000. The document can be found at http://www.unfccc.de/sessions/workshop/000314/.

## D. Key reasons for changes in the base year inventories

52. Only some Parties cited reasons for the changes in their base year estimates (see tables 8 and 9). The main reasons for the modification of LUCF estimates were as follows:[18]

(a) Adoption 1996 IPCC Revised Guidelines (Germany, Japan, Latvia, Poland);

(b) Increased use of land-clearing rates from remote sensing, updated statistics on new plantings (Australia);

(c) Availability of new data on land conversion, new planting, restocking and harvesting; modification of existing models, and change in biomass conversion ratio (New Zealand);

(d) Availability of new data (Italy);

(e) Advances in knowledge; in-depth review of first NC (Japan);

(f) Inclusion of data on agricultural land-use change, inclusion of all land-use transition and inclusion of Northern Ireland (UK);

(g) Use of new data and a revised model (Russian Federation);[19]

(h) Revision of $CO_2$ fluxes to include new sources, such as forest and non-forest soils, as well as wood harvested from public lands (USA).

53. France indicated that the details of the change are contained in a report produced by a third party. For the remaining Parties no indication related to base year recalculation of the LUCF sector was made.

54. The main reasons cited for modification of agricultural soils estimates are:

(a) Use of 1996 IPCC Revised Guidelines (Australia, Finland, Germany, Latvia, Norway, Sweden, Switzerland, USA);

(b) Use of most recent findings (Austria - no further details);

(c) New methods (Canada - no further details);

(d) Inclusion of new sources of emissions (Australia, Canada, Denmark);

(e) Estimates updated (Slovakia - no further details);

(f) More reliable data and update of methodology (Greece);

(g) Revision to account for the application of additional quantities of animal manure applied to soils (USA).

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[18] Information on revision of base year LUCF estimates between annual inventories submitted in 1998 and second NCs can be found in document FCCC/SBI/1999/5, page 11.

[19] This information was provided during the in-depth review of the second NC.

55. Japan and Spain cited general reasons for the change in estimates, not specifically for agricultural soils. France indicated that the details of the change are contained in a report produced by a third party. For the rest of the Parties no indication as to the reason for changes made to the agricultural soils base year estimates was provided.

**Table 8. Differences in base year (1990) net $CO_2$ emission estimates from LUCF between first NCs and most recent inventory submissions**

| Party | Base year estimates of net $CO_2$ emissions according to [a] | | Percentage change in net $CO_2$ emissions estimates (B-A)/A*100 | Explanation for recalculation provided |
|---|---|---|---|---|
| | First NCs [Gg] | Latest estimates [Gg] | [per cent] | |
| | A | B | C | D |
| Australia | 130 843 | 69 436 | - 47 | Yes |
| Austria | NR | - 13 300 | | |
| Belgium | - 2 057 | - 2 057 | | |
| Bulgaria [b] | - 4 657 | *- 4 657* | | |
| Canada | NR | - 44 000 | | |
| Czech Republic | - 2 280 | *- 2 281* | | |
| Denmark | - 2 600 | *- 924* | - 64 | No |
| Estonia | - 7 950 | *- 11 317* | 42 | No |
| Finland | - 31 000 | *- 31 000* | - | |
| France | - 32 168 | - 59 617 | 85 | No |
| Germany | - 20 000 | - 33 719 | 69 | Yes |
| Greece | NR | | | |
| Hungary [b] | - 3 097 | | | |
| Iceland | NR | NR | | |
| Ireland | | *- 5 160* | | |
| Italy | - 36 730 | *- 24 929* | - 32 | Yes |
| Japan | - 90 000 | - 83 903 | - 7 | In second NC |
| Latvia | - 14 300 | *- 10 826* | - 24 | Yes |
| Liechtenstein | - 22 | | | |
| Lithuania | - 8 848 | | | |
| Luxembourg | NR | *- 295* | | |
| Monaco | NR | | | |
| Netherlands | - 120 | - 1 500 | 1 150 | |
| New Zealand | - 16 716 | - 20 888 | 25 | Yes |
| Norway [c] | - 12 200 | - 9 590 | - 21 | No |
| Poland [b] | - 18 280 | *- 34 746* | 90 | Yes |
| Portugal [d] | - 70 400 | *- 14 353* | - 80 | No |
| Romania [b] | NR | *- 2 925* | | |
| Russian Fed. | - 587 200 | *- 392 000* | - 33 | Yes |
| Slovakia | - 4 451 | *- 4 257* | - 4 | No |
| Slovenia [e] | - 2 293 | | | |
| Spain | - 4 178 | *- 28 970* | 593 | |
| Sweden | - 34 368 | - 34 368 | - | |
| Switzerland | - 5 200 | *- 4 360* | - 16 | No. |
| Ukraine | - 51 976 | - 52 107 | 0.3 | |
| UK [f] | - 6 137 | 21 412 | - 449 | Yes |
| USA | - 436 000 | - 1 142 200 | 162 | Yes |

*Note:* Parties that did not provide recalculated estimates were included in this table for the purpose of illustrating reported base year estimates.

Values in *italics* indicate that the estimates are from the second NCs.

[a] A negative value indicates removals and a positive one indicates emissions.

[b] According to decision 9/CP.2, the following EIT Parties use base years other than 1990: Bulgaria (1988), Hungary (average 1985-1987), Poland (1988) and Romania (1989).

[c] Estimate from the first NC refers to the year 1992.

[d] Estimate from the first NC reflects the total removal, therefore the estimate given in the second NC refers also to the total removal. Net emissions were reported to be -1,152 Gg in the second NC.

[e] According to decision 11/CP.4, Slovenia uses the year 1986 as base year. However, data given in this table are for 1990, as no base year data were provided.

[f] Data provided under the first NC were taken from an update to the United Kingdom's climate change programme: *Climate change, the UK programme, progress report on carbon dioxide emissions*, 1995

**Table 9. Differences in base year (1990) $N_2O$ emission estimates from agricultural soils between first NCs and most recent inventory submissions**

| Party | Base year estimates of $N_2O$ emissions according to | | Percentage change in $N_2O$ emissions estimates (B-A)/A*100 [per cent] | Explanation for recalculation provided |
|---|---|---|---|---|
| | First NCs [Gg] | Latest estimates [Gg] | | |
| | A | B | C | D |
| Australia | 28.6 | 48.2 | 68.6 | Yes |
| Austria | 2.0 | 3.3 | 65.0 | Yes |
| Belgium | 10.9 | 10.9 | | |
| Bulgaria [a] | 13.4 | *13.4* | | |
| Canada | 11.0 | 100.0 | 809.1 | Yes |
| Czech Republic | 2.0 | *2.3* | 15.0 | |
| Denmark | 8.5 | *33.0* | 288.2 | Yes |
| Estonia [b] | 1.0 | *0.9* | -5.3 | |
| Finland | 10.0 | 10.1 | 0.8 | Yes |
| France | 61.1 | 171.3 | 180.4 | In NC2 |
| Germany | 69.0 | 85.0 | 23.2 | In NC2 |
| Greece | 7.4 | 20.6 | 178.4 | In NC2 |
| Hungary [a] | 4.6 | | | |
| Iceland | 0.5 | *0.2* | -57.4 | No |
| Ireland | 39.5 | *23.3* | -40.9 | No |
| Italy | 56.6 | *62.1* | 9.7 | No |
| Japan | 4.0 | 3.8 | -5.0 | In NC2 |
| Latvia | 1.4 | *22.0* | 1528.4 | Yes |
| Liechtenstein | NR | | | |
| Lithuania [b] | 10.8 | | | |
| Luxembourg | NR | *0.5* | | |
| Monaco | NR | NR | | |
| Netherlands | 22.1 | 21.5 | -2.7 | No |
| New Zealand | 1-37*** | 36.1 | | |
| Norway | 6.0 | 4.0 | -33.3 | Yes |
| Poland [a, c] | 72.0 | *43.0* | -40.3 | No |
| Portugal | 3.6 | *7.4* | 104.2 | No |
| Romania [a] | NR | *25.1* | | |
| Russian Federation | NR | *IE* | | |
| Slovakia | 8.8 | *9.5* | 8.0 | Yes |
| Slovenia [d] | 4.6 | | | |
| Spain | 63.0 | 63.2 | 0.3 | |
| Sweden | 7.9 | 15.0 | 89.9 | Yes |
| Switzerland | 26.7 | *9.2* | -65.5 | Yes |
| Ukraine | 10.2 | NR | | |
| United Kingdom | 4.0 | 95.1 | 2276.8 | |
| USA | 200.0 | 773.0 | 286.5 | Yes |

*Note:* Parties that did not provide recalculated estimates were included in this table for the purpose of illustrating reported base year estimates.

Values in *italics* indicate that the estimates are from the second NCs.

[a] According to decision 9/CP.2, the following EIT Parties use base years other than 1990: Bulgaria (1988), Hungary (average 1985-1987), Poland (1988) and Romania (1989).

[b] Estimates provided by the Party refer to the agriculture sector as a whole, but information provided in the national communication or inventory submission indicates that these emissions mainly stem from agricultural soils.

[c] A range, 0-144 Gg was also provided in the first NC.

[d] According to decision 11/CP.4, Slovenia uses the year 1986 as base year. However, data given in this table are for 1990, as no base year data were provided.

IE: Included elsewhere

## VI. REPORTING OF METHODS AND SOURCES OF DATA USED FOR ESTIMATING GHG INVENTORIES

### A. Reporting on methods used for estimating GHG emissions and removals

56. In the latest GHG inventories, 15 Parties reported the methods used for estimating GHG emissions and removals from the LUCF sector and the agricultural soils category (table 10). Six Parties used the Revised 1996 IPCC Guidelines default method without any qualification, and four Parties used methods *based* on the Revised 1996 IPCC Guidelines default methods. Two Parties used their own methods which conform to IPCC methods, and another 12 Parties used the IPCC reporting format, but did not specify the methods. One Party used the IPCC methodology, but did not report data in the standard IPCC tables, as the relevant activity data were only available as an average of information gathered during several decades prior to 1990.

57. In their second national communications, 20 Parties reported the use of methods for estimating emissions and removals for the LUCF sector and agricultural soils category. Nine Parties reported the use of "IPCC Guidelines", "IPCC methodology" or "1995 IPCC Guidelines". Three Parties used the 1996 Revised IPCC Guidelines while two Parties reported methods based on IPCC guidelines. Four Parties in Europe used the CORINAIR method. Australia, the United Kingdom and the USA reported the methods they used in separate reports. Details are provided in table 10 for those Parties for which information is available.

**Table 10: Reporting of methods used for GHG inventories and/or second national communications[a]**

| Party | Methods used for estimates in LUCF sector | Methods used for estimates in agricultural soils category |
|---|---|---|
| Australia | INV99: methods that conforms to 1996 IPCC.[b]<br>NC2: 1997 Workbook in LUCF | INV99: methods that conforms to 1996 IPCC.[b]<br>NC2: based on IPCC methodology |
| Austria | INV99: CORINAIR<br>NC2: CORINAIR | INV99: CORINAIR<br>NC2: CORINAIR |
| Belgium | INV99: NR<br>NC2: IPCC | INV99: NR<br>NC2: IPCC and CORINAIR |
| Bulgaria | INV99: 1996 IPCC<br>NC2:1995 IPCC | INV99: 1996 IPCC<br>NC2: 1995 IPCC |
| Canada | INV99: Based on 1996 IPCC<br>2nd: Based on 1995 and 1996 IPCC[c] | INV99: Based on 1996 IPCC<br>NC2: Based on 1996 IPCC[c] |
| Czech Republic | INV99: NR<br>NC2: 1995 IPCC | INV99: NR<br>NC2: 1995 IPCC |
| Denmark | INV99: NR<br>NC2: CORINAIR | INV99: NR<br>NC2: CORINAIR; 1996 Revised IPCC |
| Estonia | INV99: NR<br>NC2: IPCC | INV99: NR<br>NC2: IPCC |
| Finland | INV99/NC2: NE | INV99/NC2: IPCC |
| France | INV99: NR<br>NC2: CORINAIR | INV99: NR<br>NC2: CORINAIR |
| Germany | INV99: method based on 1996 IPCC<br>NC2: NR | INV99: NR<br>NC2: 1996 IPCC |
| Greece | NE | INV99: CORINAIR<br>NC2: CORINAIR |
| Hungary | 1999 GI: IPCC<br>NC2: IPCC | INV99: IPCC<br>NC2: IPCC |

**Table 10** ***(continued)***

| | | |
|---|---|---|
| Iceland | INV99: NR<br>NC2: NR | INV99: NR<br>NC2: 1995 IPCC |
| Ireland | INV99: NR<br>NC2: CORINAIR | INV99: NR<br>NC2: CORINAIR |
| Italy | 1999G/NCI2: 1996 IPCC | INV99/NC2: 1996 IPCC |
| Japan | INV99: NR<br>NC2: 1996 IPCC | INV99: NR<br>NC2: 1996 IPCC |
| Latvia | INV99: NR<br>NC2: 1996 IPCC | INV99: NR<br>NC2: 1996 IPCC |
| Netherlands | INV99: Based on 1996 IPCC<br>NC2: Based on IPCC | INV99: Based on 1996 IPCC<br>NC2: Based on IPCC |
| New Zealand | INV99: NR<br>NC2: IPCC | INV99: NR<br>NC2: IPCC |
| Norway | INV99: Partly based on 1996 IPCC; country specific emission factors<br>NC2: IPCC | INV99: Partly based on 1996 IPCC; country-specific emission factors<br>NC2: IPCC |
| Poland | INV99: NR<br>NC2: 1995 IPCC | INV99: NR<br>NC2: 1995 IPCC |
| Portugal | INV99: IFCC<br>NC2: NR | INV99: IPCC<br>NC2: NR |
| Romania | INV99: IPCC<br>NC2: IPCC | INV99: IPCC<br>NC2: IPCC |
| Russian Federation [d] | INV99: based on recent forest inventory plus IPCC<br>NC2: "the Carbon and Climate in Boreal Forests" model. | |
| Slovakia | INV99: 1996 IPCC<br>NC2: IPCC | INV99: 1996 IPCC<br>NC2: IPCC |
| Spain | INV99: NE<br>NC2: Based on IPCC | INV99: NR<br>NC2: CORINAIR |
| Sweden | INV99: 1996 IPCC<br>NC2: NE | INV99: 1996 IPCC<br>NC2: IPCC |
| Switzerland | INV99: 1996 IPCC<br>NC2: IPCC for LUCF, 1996 IPCC for agricultural soils | 199GI/NC2: 1996 IPCC |
| United Kingdom | INV99: NR<br>NC2: Details in the "UK Greenhouse Gas Inventory 1999 to 1994" | INV99: NR<br>NC2: Details in the "UK Greenhouse Gas Inventory 1999 to 1994" |
| USA | INV99: NR<br>NC2: Methods similar to 1995 IPCC | INV99: NR<br>NC2: Methods similar to 1995 IPCC |

Notation keys: NR - not reported; NE - not estimated; NO - not occurring; IE - estimated but included elsewhere. Blank - Party did not report a value, but left cell "blank".

[a] In this table the 1996 Revised IPCC Guidelines are referenced as 1996 IPCC, and the 1995 IPCC Guidelines as 1995 IPCC. If the version used was not specified, the term "IPCC" is used.

[b] Australia used the "Australian Methodology for the Estimation of Greenhouse Gas Emissions and Sinks" which conforms to the 1996 IPCC Guidelines

[c] Details are provided in *Canada's Greenhouse Gas Inventory – 1997 Emissions and Removals with Trends*

[d] Information derived from in-depth review

## B. Reporting on sources of activity data and/or emission factors

58. Seven Parties reported the specific source of activity data for LUCF that was used in the latest GHG inventory, and 11 Parties reported sources of activity data in their second NC. Table 11 lists the origin of the activity data. Parties for which no information was available have not been included in the table.

**Table 11: Sources of activity data for the LUCF sector as reported in the latest submission**

| Party | Area converted | Biomass (before conversion) | Annual growth rate | Area of forest |
|---|---|---|---|---|
| Australia [a] | NR in NC2. INV99: Updated statistics from Bureau of Resource Sciences (1999) | NR | NR | NR in NC2 INV99: Updated statistics on new plantings and area established (Bureau of Resource Sciences, 1999) |
| Bulgaria | NE | NE | Forest inventory data | Forest inventory data |
| Denmark | National Environmental Research Institute | | | |
| Germany [a] | NE | NE | Federal Forest Inventory Forest Fund Database | Federal Ministry of Food, Agriculture and Forestry (BML) |
| Italy [a] | Country data | Country data | Forest Inventory for Umbria region National Forest Inventory | National statistics |
| Japan | Statistical Handbook of Forestry, Forestry Agency | | | |
| New Zealand | National Exotic Forest Description (NEFD), | | | |
| Norway [a] | NE | NE | Norwegian Forest Research Institute (NISK) | |
| Poland | Directorate General (State Forests Enterprise) | | | |
| Portugal | NE | NE | National Forest Inventory | |
| Russian Federation | Federal Forest Service [b] | | | |
| Switzerland [a] | NE | NE | Swiss National Forest Inventory (Inventaire forestier national Suisse, 1988) | Swiss National Forest Inventory (Inventaire forestier national Suisse, 1988) |
| USA | Details in "1995 Inventory of US Greenhouse Gas Emissions and Sinks: 1990-1994" (United States Environmental Protection Agency, 1995) | | | |

[a] Activity data source also reported in 1998/1999 GHG inventory.
[b] Information derived from in-depth review.

59. For the agricultural soils category, five Parties reported the source of activity data and/or emission factors in their latest GHG inventory, whilst the others did not. In the second NC, six Parties provided the source of activity data and/or emission factors. Four Parties referred to separate reports containing information on activity data and/or emission factors. More detail is provided in table 12. Parties for which no information was available have not been included in the table.

**Table 12: Sources of activity data and emission factors for agricultural soils from the latest submissions**

| Party | Source of activity data and emission factors |
|---|---|
| Canada | NR, instead reference to Canada's Greenhouse Gas Inventory- 1997 Emissions and Removals with Trends |
| Denmark | National Environmental Research Institute |
| Finland[a] | Data from standard statistics<br>Emission factors from IPCC Guidelines (from Mosier, 1994)<br>Ammonia emissions model by VTT energy<br>$N_2O$ emissions from peatlands taken from Finnish Research Programme on Climate Change (SILMU) |
| Greece[a] | National Statistical Service of Greece; Ministry for the Environment, Physical Planning and Public Works; Emission factors from CORINAIR and IPCC |
| Hungary | IPCC emission factors |
| Ireland | Factors based on research by the Irish Agricultural Research Institute (Teagasc) |
| Italy[a] | ISTAT (1991); FAO database; Erdman, 1959 in Agronomia Generale p.205; ad hoc survey; Agricultural and Agri-Industrial By-Products, Vol. 1 (Cestaat); CNR-CRPA survey; Carta Pedalogica, 1961; emission factors IPCC values modified |
| Japan | Amount of fertilizer from "Pocket Handbook of Fertilizers" (MAFF)<br>Emission factors from studies of MAFF |
| Netherlands | NR, instead reference to Spakman *et al*, 1996. |
| Sweden[a] | IPCC emission factors |
| Switzerland[a] | Swiss Farmers Association data base<br>Dry biomass content from Souci et al. (1981)<br>Area of histosols from Presler and Gysi (1989)<br>IPCC default emission factors except for crop fraction burned on fields |
| United Kingdom | NR, instead reference to "UK Greenhouse Gas Inventory, 1990 to 1994" NETC(1996) |
| USA | NR, instead reference to "1995 Inventory of US Greenhouse Gas Emissions and Sinks: 1990-1994" (US EPA, 1995) |

[a] Reported activity data source also in 1998/1999 GHG inventory.

## C. Reporting of uncertainty

60. In the latest GHG inventory, three Parties reported quantitative estimates of uncertainty for both LUCF (Australia, Belgium, Canada) and agricultural soils (Australia, Canada, Switzerland). Belgium reported 50 per cent uncertainty for $N_2O$ emissions in general.

61. The following Parties described uncertainty in the LUCF sector qualitatively:
- Finland: uncertainties for $N_2O$ are very large for the agricultural soils category;
- Germany: "considerable uncertainties" in emission estimates in general;
- Greece: considerable uncertainty for emission factors of gases other than $CO_2$;
- Hungary: the effect of political and economic changes in the country on the increased unreliability of LUCF estimates is discussed;
- Norway: a third party conducted an uncertainty study. Details for the LUCF sector and the agricultural soils category are not provided. The main weaknesses of the inventory include nitrous oxide from agriculture, and;
- Switzerland: uncertainty in the LUCF sector is considerable but no quantitative estimate is provided.

62. In the second NC, four Parties reported a quantitative estimate of uncertainty for the LUCF sector. Canada reported 4 per cent uncertainty for $CO_2$ emissions in general, and five Parties reported uncertainty qualitatively (low, medium or high) based on IPCC table 8A.

63. For the agricultural soils category, five Parties reported quantitative estimates of uncertainty. Canada reported 40 per cent uncertainty for $N_2O$ in general. Estonia estimated uncertainty at 10-25 per cent depending on the sector, but did not specify the values for the LUCF sector or the agricultural soils category. Four Parties reported the quality of estimates (L, M, H) based on IPCC table 8A. Two Parties provided a qualitative description of uncertainty. The information on uncertainty is summarized in table 13. Parties for which no information was available have not been included in the table.

**Table 13: Reporting of uncertainty for LUCF and agricultural soils by Annex I Parties**

| Party | 1998/1999 GHG inventory | | Second national communication | |
|---|---|---|---|---|
| | LUCF | Agricultural soils | LUCF | Agricultural soils |
| Australia | 20-70 per cent | 20-80 per cent | > 80 per cent | 20-80 per cent |
| Belgium | 25 per cent | 50 per cent for $N_2O$ | | |
| Bulgaria | NR | NR | H[b] | M[b] |
| Canada | >100 per cent | 40 per cent | 4 per cent for $CO_2$[a] | 40 per cent for $N_2O$[a] |
| Czech Republic | NR | NR | $CO_2$ emissions = 8-10 per cent | 80-100 per cent |
| Estonia | NR | NR | NR[c] | NR[c] |
| Finland | Not applicable | "Very large" | Not applicable | NR |
| Greece | Not applicable | NR[d] | NR | NR |
| Hungary | NR[e] | Not applicable | NR | NR |
| Iceland | Not applicable | Not applicable | NR | "High degree" |
| Italy | Not applicable | Not applicable | Not available | Not available |
| Japan | NR | NR | $CO_2$: M; others: L[b] | L[b] |
| Latvia | NR | NR | Not available | Not available |
| Liechtenstein | Not applicable | Not applicable | Not applicable | Not applicable |
| Lithuania | NR | NR | Not available | Not available |
| Luxembourg | Not applicable | Not applicable | Not applicable | Not applicable |
| Monaco | Not applicable | Not applicable | Not applicable | Not applicable |
| Netherlands | NR | NR | $CO_2$= M[b] | Emission factors: 50-100 per cent<br>Overall: ca. 50 % |
| New Zealand | NR | NR | $CO_2$: 20,571 ±5,143<br>$CH_4$: 5.0 ± 2.5 | 44.9 ± 26.9 |
| Norway | Consultancy study conducted. | | NR | "Large degree" |
| Portugal | Not applicable | Not applicable | NR | M[b] |
| Romania | Not applicable | Not applicable | NR | NR |
| Slovakia | NR | NR | 30 per cent | 100 per cent |
| Slovenia | Not applicable | Not applicable | Not applicable | Not applicable |
| Spain | Not applicable | NR | From M to one order of magnitude[f] | |
| Sweden | NR | NR | M[b] | L[b] |
| Switzerland | Considerable | -80 to 130 per cent | H[b] | NR |
| Ukraine | NR | NR | Not available | Not available |

*Notes:* Not applicable = LUCF or agricultural soils not estimated; 1998/1999 inventory or NC2 not submitted.

[a] For $CO_2$ and $N_2O$ in general; not specific for LUCF and agricultural soils.
[b] Based on quality of estimates ranking of IPCC table 8A.
[c] 10-25 per cent depending on the sector.
[d] Considerable uncertainty for emission factors of gases other than $CO_2$.
[e] The effect of political and economic changes in the country on the increased unreliability of LUCF estimates discussed.
[f] In accordance with the CORINAIR approach of reporting quality of the data.

## VII. SUMMARY

### A. Issues related to reporting GHG emissions and removals in the LUCF sector and agricultural soils category

64. $CO_2$ emissions and removals from the LUCF sector are reported in the latest submission by 32 Parties. The data are for different years: 22 Parties reported for 1997, two for 1998,[20] and others for earlier years. Similarly, GHG emissions and removals for agricultural soils are reported by 32 Parties, 21 of which have reported for 1997.

65. The revised guidelines for the preparation of national communications by Parties included in Annex I to the Convention, request Parties to report inventories using the formats recommended in the IPCC Guidelines (decision 9/CP.2), which includes summary tables, sectoral tables, overview tables, and worksheets or equivalent information, including activity data and emission factors. The worksheets for LUCF and agricultural soils are explicitly requested. Until the adoption of decision 3/CP.5 on UNFCCC reporting guidelines for annual inventories of Annex I Parties, no specific guidance existed on how annual inventories should be reported. These newly adopted UNFCCC guidelines explicitly request Parties to report emission factors and activity data through the national inventory report and the common reporting format. This lack of specific guidance for annual inventories may have caused Parties to submit different information and individual Parties to submit reports which varied from year to year.

66. In the latest submissions, all reporting Parties provided summary tables, and a further:

(a) Twenty-one Parties provided sectoral tables for the LUCF and agriculture sector (this includes those that did not follow the IPCC format);

(b) Seven Parties provided worksheets;

(c) Fifteen Parties reported overview tables, some with data quality indicators;

(d) Eight Parties provided information on activity data and emission factors; and

(e) Twelve Parties used notation keys.

67. Thirty-one Parties reported estimates of $CO_2$ emissions or removals from the LUCF sector: 30 Parties reported removals, of which 12 reported both $CO_2$ emissions and removals. One Party reported emissions only.[21]

68. The LUCF sector constitutes a net sink primarily due to the category "changes in forest and other woody biomass stocks" (category 5A). Three of the 11 Parties reporting emissions and/or removals for "forest and grassland conversion" (category 5B), did not provide estimates for both $N_2O$ and $CH_4$, even though the IPCC Guidelines provide default methods for estimating

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[20] 1998 data are not included in the analysis. Instead, for these Parties 1997 data were used as for the majority of other Parties.

[21] Attention is drawn to the footnotes to tables 5, 7A and 7B in volume 1 of the IPCC Guidelines. The IPCC Guidelines request Parties not to provide an estimate of both $CO_2$ emissions and $CO_2$ removals. Instead Parties are requested to provide an estimate of net $CO_2$ emissions and to place a single number in either the $CO_2$ emissions or $CO_2$ removals column, as appropriate. Sixteen Parties estimated $N_2O$ and/or $CH_4$ emissions.

these gases on the basis of category 5B. The majority of the Parties did not report emissions from soils (category 5D).[22] It is not clear whether emissions are, or are not occurring. $CO_2$ emissions from soils were reported by five Parties while $CO_2$ removals were reported by two Parties. In addition, Canada and Iceland reported emissions from agricultural soils under category 4D.

69. Twenty-seven Parties reported that $CO_2$ removals from LUCF were higher than their $CO_2$ emissions. Australia, Estonia, Lithuania, and the United Kingdom indicated that the LUCF sector is a net source of $CO_2$ emissions. The LUCF sector offset approximately 15 per cent of the total $CO_2$ emissions from all sectors (excluding LUCF). In comparison, $CO_2$ equivalent emissions from all other sectors (excluding LUCF) offset approximately 12 per cent of the aggregate $CO_2$ equivalent emissions.[23]

70. Thirty-two Parties reported $N_2O$ emissions from agricultural soils. $N_2O$ accounted for 90 per cent of the $CO_2$ equivalent GHG emissions from agricultural soils. Seven Parties reported emissions of $CH_4$ and one Party removals of this GHG. Two Parties reported $CO_2$ emissions from this category. No removals of $CO_2$ were reported.

71. Synthesizing information reported by Parties is complicated by the following factors:

(a) Time-series of reported data are incomplete for many years for a number of Parties;

(b) Worksheets, including activity data and emission factors, are not always provided;

(c) The real meaning of "cells with no values" or "zero" is not clear in some cases;

(d) Different methods of reporting were used by different Parties, and in different years for the same Party.

72. Another factor influencing the level of detail of reporting and the frequency, may be the technical capacity of some Parties to estimate emissions from sources and removals by sinks in the LUCF sector and agricultural soils category.

### B. Reporting and recalculation of base year emissions

73. A great majority of the Parties reported base year $CO_2$ emission and removal estimates for the LUCF sector and $N_2O$ emission estimates for the agricultural soils category (78 and 86 per cent, respectively) in their first national communications. Similarly, more than 80 per cent of the Parties provided base year estimates for LUCF and agricultural soils in a later GHG inventory (second NC and/or annual inventory submission). For approximately half of the reporting Parties, the latest base year estimates available are from the second NCs, because base year inventories were not provided in recent annual inventory submissions.

74. Two-thirds of the Parties reporting LUCF estimates in their first NC revised their estimates in their second NC and/or annual inventory; changes ranged from minus 80 per cent to

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[22] According to the IPCC Guidelines (Volume 3. Reference Manual, pp. 4.2, 4.87), $CO_2$ emissions from agricultural soils are to be included under LUCF. At the same time, table 7A (summary report for national GHG inventories in volume 1: IPCC Reporting Instructions) allows for reporting $CO_2$ emissions or removals from agricultural soils, either in the agriculture sector (under D: agricultural soils) or in the LUCF sector (under D: emissions and removals from soil).

[23] The percentages in this paragraph are approximations only, derived from reported values for different years. These values should therefore be seen as indicative only.

a 10-fold increase compared to the originally reported estimates. Base year $N_2O$ emission estimates from agricultural soils were revised by more than 80 per cent of the Parties that provided estimates in their first NC. For this category large changes in the estimates were found, ranging from minus 66 per cent to more than a 23-fold increase when compared to the original estimates from the first NCs.

75. Only some Parties reported the reasons why base year estimates from LUCF and agricultural soils had been recalculated. The most common reason was the use of the Revised 1996 IPCC Guidelines, which influenced particularly the agricultural soils category, by including additional sources. The availability of improved data was also mentioned. In general, recalculations are the current practice in preparing GHG inventories when new inventory information becomes available and as Parties seek to improve the quality and accuracy of their estimates.

### C. Reporting of methods and sources of data

76. Fifteen Parties reported the methods used for estimating removals and emissions from the LUCF sector in the latest GHG inventory and second national communication, and 20 Parties for the agricultural soils category. Of these, only six Parties indicated the use of the IPCC Guidelines without any qualification, whilst four reported that the methods used were based on the IPCC Guidelines, and two Parties used their own methods which conform to IPCC reporting format.

77. Only seven and five Parties reported the sources of their activity data and emission factors in both the LUCF sector and agricultural soils category respectively. Most Parties did not report methods for estimating uncertainty. In the LUCF sector, only three Parties reported uncertainty quantitatively and 10 Parties qualitatively in the latest GHG inventory and the second national communication. Three Parties reported uncertainties associated with emissions from the agricultural soils category in their latest GHG inventory, and 13 Parties in their second national communication.

## Appendix I : Net $CO_2$ emissions from LUCF sector, 1990-1997 (Gg)

| Party | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 |
|---|---|---|---|---|---|---|---|---|
| Australia | 69 436 | 42 399 | 39 166 | 44 672 | 35 263 | 33 800 | 37 454 | 34 050 |
| Austria | -13 300 | -15 301 | -17 893 | -17 775 | -14 726 | -13 576 | -13 753 | -13 753 |
| Belgium | -2 057 | -2 057 | -2 057 | -2 057 | -2 057 | -2 057 | -2 057 | -2 057 |
| Bulgaria [b] | -5 801 | -7 880 | -7 636 | -7 022 | -6 974 | -7 520 | | -5 852 |
| Canada | -44 000 | -53 000 | -43 000 | -31 000 | -26 000 | -19 000 | -31 000 | -19 000 |
| Czech Republic | -2 281 | -5 027 | -6 041 | -5 643 | -3 943 | -5 454 | -4 479 | -4 639 |
| Denmark | -924 | -932 | -940 | -948 | -956 | -964 | -981 | -997 |
| Estonia | -11 317 | | | | -11 125 | -13 266 | | 7 993 |
| Finland [a] | -30 600 | | | | | | | |
| France | -59 617 | -56 488 | -61 246 | -65 865 | -67 495 | -65 615 | -67 197 | -67 772 |
| Germany | -33 719 | -33 719 | -33 719 | -33 719 | -33 719 | -33 493 | -33 493 | -33 493 |
| Greece | | | | | | | | |
| Hungary [b] | -4 467 | -3 239 | -3 823 | -4 697 | -4 820 | -4 797 | -3 931 | |
| Iceland | | | | | | | | |
| Ireland | -5 160 | -5 390 | -5 580 | -5 760 | -5 970 | -6 230 | -6 497 | |
| Italy | -24 949 | | | | -24 831 | -24 507 | | |
| Japan | -83 903 | -83 865 | -85 568 | -90 084 | -93 545 | -96 706 | | |
| Latvia | -10 826 | -14 186 | -14 235 | -14 228 | -14 206 | -10 484 | -14 320 | -14 315 |
| Liechtenstein | -22 | | | | | | | |
| Lithuania | -8 848 | | | | | 2 800 | 2 800 | 2 800 |
| Luxembourg | -295 | | | | -295 | -295 | -295 | |
| Monaco | | | | | | | | |
| Netherlands | -1 500 | -1 600 | -1 600 | -1 600 | -1 700 | -1 700 | -1 700 | |
| New Zealand | -20 888 | -19 443 | -16 469 | -14 877 | -13 991 | -15 145 | -15 549 | -17 008 |
| Norway | -9 590 | -11700 | -13 250 | -13 510 | -15 680 | -13 640 | -17 611 | -16 499 |
| Poland [b] | -44 663 | | -40 815 | | -41 953 | | -42 617 | -40 521 |
| Portugal | -1 152 | -1 152 | -1 152 | -1 152 | -1 152 | | | |
| Romania [b] | -5 646 | -6 590 | -6 590 | -6 590 | -6 590 | | | |
| Russian Fed. | -392 000 | | | | -568 000 | -840 000 | -840 000 | |
| Slovakia | -4 257 | -4 257 | -4 257 | -4 257 | -5 118 | -5 116 | -5 281 | |
| Slovenia [b] | -2 294 | | | | | | | |
| Spain [a] | -28 970 | -28 970 | -28 970 | -28 970 | -28 970 | | | |
| Sweden | -34 368 | | | | | | -31 774 | -31 774 |
| Switzerland | -4 360 | -4 380 | -4 430 | -5 160 | -5 150 | -5 100 | -5 200 | -5 355 |
| Ukraine | -52 107 | -52 964 | -52 658 | -52 917 | -52 721 | -52 940 | -66 151 | -68 806 |
| United Kingdom | 21 413 | 21 479 | 20 938 | 19 048 | 16 470 | 15 366 | 15 609 | 15 518 |
| USA | -1 142 200 | -1 142 200 | -1 142 200 | -764 700 | -764 700 | -764 700 | -764 700 | -764 683 |
| TOTAL | -1 995 232 | -1 490 462 | -1 534 025 | -1 108 811 | -1 764 714 | -1 950 339 | -1 912 723 | - 1 046 163 |

*Source:* INV 99, INV 98, NC1, NC2 and FCCC/SBI/1999/12.

[a] Finland and Spain did not provide any values in their most recent submissions but had provided data in earlier submissions or second NC.

[b] Bulgaria, Hungary, Poland, Romania and Slovenia have base years other than 1990 (see decisions 9/CP.2 and 11/CP.4) which are respectively: 1989, an average of the years 1985-1987, 1988, 1989, and 1986. The first four of these Parties reported net $CO_2$ emissions from the LUCF sector for those years to be: -4657 Gg, -3097 Gg, -34746 Gg, and -2925 Gg.

**Appendix II: $N_2O$ emissions from agricultural soils (4D) for the period 1990-1997 (Gg) as reported in the latest submissions of annual inventories and national communications**

| Parties | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 |
|---|---|---|---|---|---|---|---|---|
| Australia | 48.21 | 48.62 | 48.24 | 49.31 | 49.77 | 49.10 | 47.70 | 49.83 |
| Austria | 3.30 | 3.31 | 3.32 | 3.33 | 3.30 | 3.26 | 3.26 | 3.26 |
| Belgium | 10.89 | 10.89 | 10.86 | 10.73 | 9.38 | 9.38 | 9.36 | 9.36 |
| Bulgaria [c] | 8.2 | 5.9 | 3.5 | 2.8 | 2.60 | 2.50 | | 2.46 |
| Canada | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| Czech Republic | 2.3 | 2.0 | 1.7 | 1.8 | 1.8 | 1.7 | 12.0 | 11.31 |
| Denmark | 33 | 32 | 32 | 31 | 30 | 30 | 30.2 | 24.05 |
| Estonia | | | | | | | | 0.03 |
| Finland [a] | 10.10 | 6.0 | 5.0 | 5.0 | 5.0 | 9.25 | 9.00 | 8.80 |
| France | 171.33 | 169.73 | 164.83 | 159.57 | 160.86 | 161.73 | 164.53 | 167.62 |
| Germany | 85.00 | 78.00 | 74.00 | 73.00 | 77.00 | 76.60 | 76.00 | 76.00 |
| Greece | 20.64 | 20.52 | 19.48 | 19.24 | 19.53 | 18.84 | 19.11 | 19.62 |
| Hungary [c] | 4.6 | 1.68 | 1.63 | 1.46 | 1.80 | 1.61 | 1.68 | |
| Iceland | 0.22 | 0.21 | 0.2 | 0.19 | 0.19 | 0.19 | | |
| Ireland [a] | 23.34 | 18.66 | 18.70 | 19.01 | 19.11 | 19.11 | 18.98 | |
| Italy | 62.1 | | | | 63.50 | 63.50 | | |
| Japan | 3.78 | 3.57 | 3.56 | 3.55 | 3.49 | 3.27 | 2.10 | 1.04 |
| Latvia [a] | 22 | 19.3 | 18.8 | 17 | 16.3 | 15.73 | 15.64 | 3.13 [e] |
| Liechtenstein | | | | | | | | |
| Lithuania [b] | 10.8 | | | | | | | |
| Luxembourg | 0.475 | | | | 0.482 | 0.475 | 0.482 | |
| Monaco | | | | | | | | |
| Netherlands | 21.50 | 22.20 | 25.50 | 25.40 | 25.60 | 26.80 | 26.70 | |
| New Zealand | 36.1 | 35.7 | 35.7 | 36.1 | 36.4 | 36.5 | 36.4 | 36.10 |
| Norway | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| Poland [c] | 41 | | 32 | | 30 | | 30.4 | 31.15 |
| Portugal | 7.35 | 7.39 | 7.20 | 7.08 | 7.16 | | | |
| Romania [b, c] | 20.5 | 6.512 | | | | | | |
| Russian Federation | | | | | | | 105.00 | |
| Slovakia | 9.46 | 8.47 | 6.61 | 5.26 | 5.35 | 5.40 | 5.50 | |
| Slovenia [c] | 4.57 | | | | | | | |
| Spain | 63.16 | 62.40 | 61.55 | 59.81 | 57.25 | 58.38 | | |
| Sweden | 15.00 | | | | | | 15.00 | 14.00 |
| Switzerland | 9.2 | 9.2 | 9.15 | 9.06 | 8.92 | 8.82 | 8.7 | 8.50 |
| Ukraine [b] | | | | | | | | |
| United Kingdom | 95.07 | 94.63 | 89.18 | 87.53 | 89.89 | 90.43 | 90.90 | 93.87 |
| USA [d] | 738 | 750 | 771 | 758 | 833 | 795 | 812 | 876.17 |
| TOTAL [f] | 1685 | 1521 | 1548 | 1489 | 1662 | 1592 | 1645 | 1540 |

[a] Data from earlier submissions have been included to obtain a more complete time series.

[b] These Parties did not provide sectoral tables for the agriculture sector. Lithuania combined its information with the LUCF sector.

[c] As per decision 9/CP.2, Bulgaria is allowed to use 1989 as a base year, Hungary the average of the years 1985-1987, Poland 1988, and Romania 1989. As per decision 11/CP.4, Slovenia is allowed to use 1986 as a base year.

[d] Inventory data submitted in 1998 have been used for the sake of a complete time series.

[e] This value was not reported in the summary table but in the sectoral background table in the 1999 submission.

[f] Figures rounded to the nearest integer.

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